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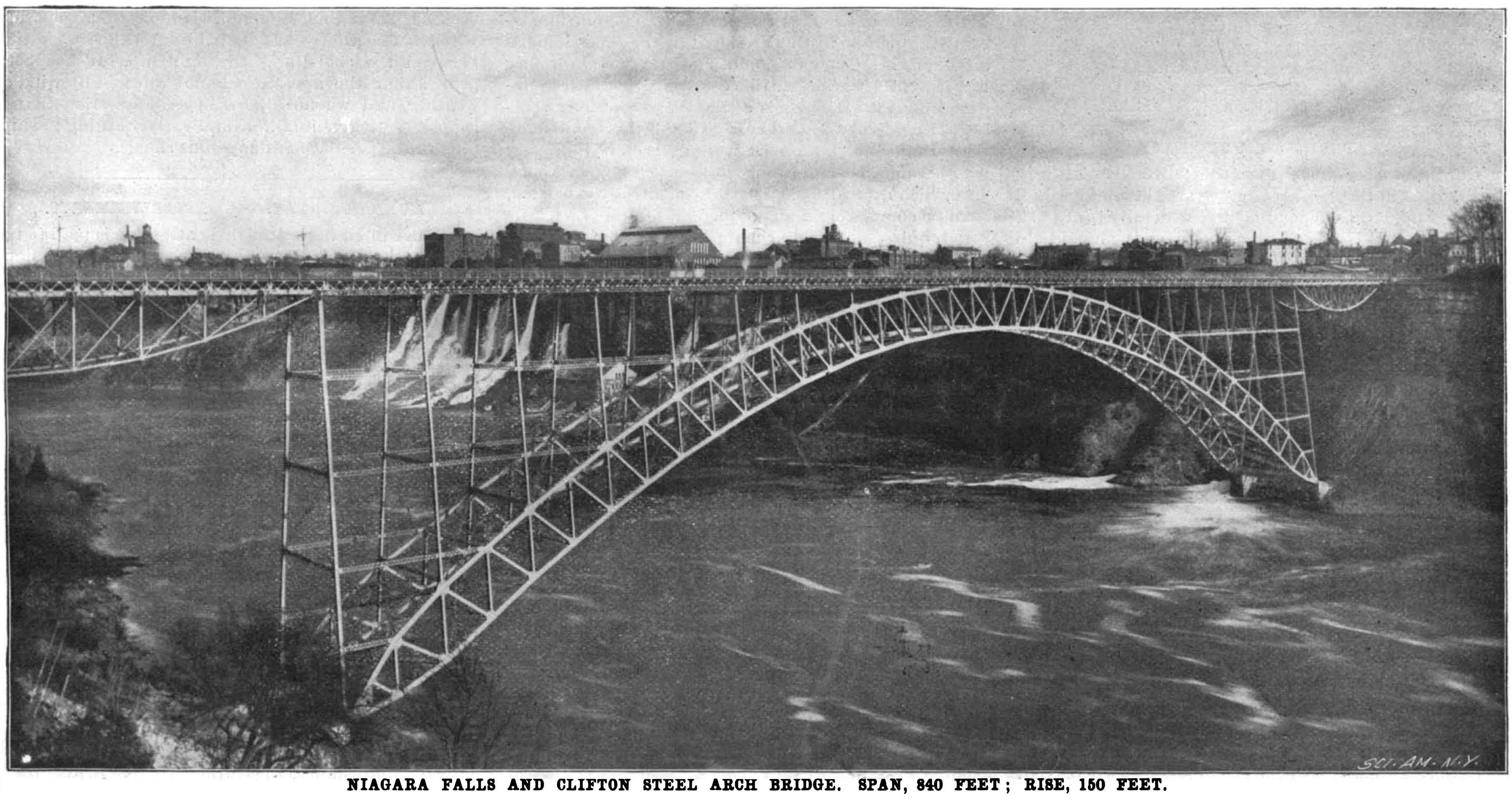
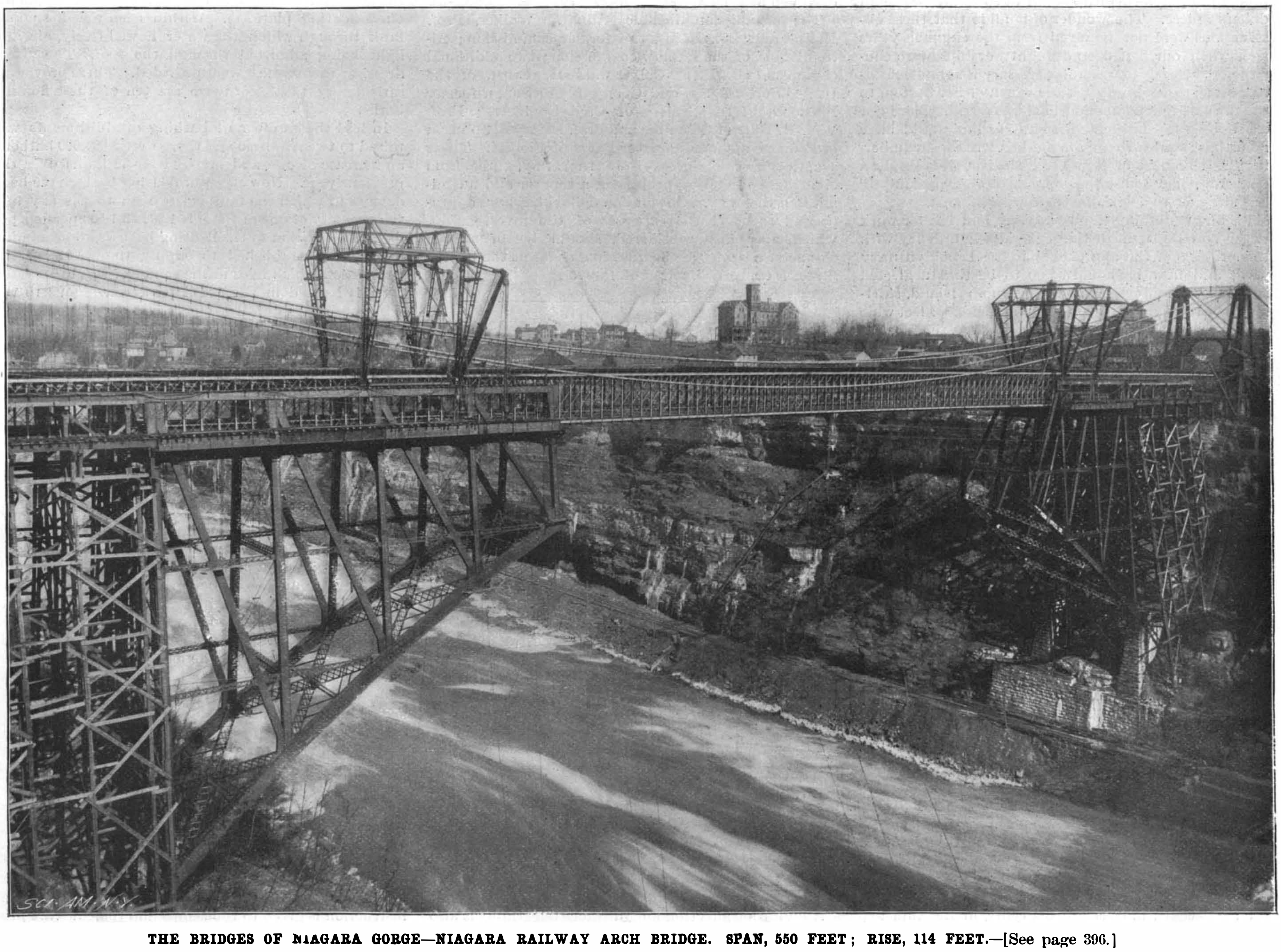


NIAGARA FALLS AND CLIFTON STEEL ARCH BRIDGE. SPAN, 840 FEET; RISE, 150 FEET.



THE BRIDGES OF NIAGARA GORGE—NIAGARA RAILWAY ARCH BRIDGE. SPAN, 550 FEET; RISE, 114 FEET.—[See page 396.]

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NEW YORK, SATURDAY, JUNE 17, 1899.

A PERIL TO THE NAVY.

Our finest armored cruiser, the "Brooklyn," is now in dry dock at the Brooklyn navy yard, having her hull patched up, straightened out and generally bent back into shape. It is only a few weeks since the battleship "Massachusetts" was in the same dock, undergoing the same treatment. In both cases these fine ships were disabled within a mile or so of the Brooklyn navy yard and at a time when they were steering a correct course through the proper harbor channels. The "Massachusetts," when the mishap occurred, was on the way to join Admiral Sampson's squadron, and though she was fully equipped for sea, with all stores on board, and down to her maximum draught, she should nevertheless have had ample water in the channels between the navy yard and the sea. As it was she grounded heavily on the Diamond Shoal, a reef that extends into the channel from Governor's Island, and received injuries which took many months to repair and cost the government about $50,000. The "Brooklyn" grounded, or struck a sunken obstruction, when in mid-channel between Governor's Island and the Battery, on her way to the Decoration-day services at Grant's Tomb. Her bottom plates were indented, rivets sheared off, and damage done that will cost about $8,000 to repair.

How long is this kind of thing to continue? If the recurrence of such preventible disasters were not suggestive of the grave perils to which the navy is exposed, it would become positively ridiculous—with such imperturbable gravity do we wreck our ships, and then proceed to patch them up again at so many thousand dollars apiece. The wonder of it all is that these obstructions were not removed from the channels years ago, when our first deep-draught warships were constructed. Surely it was not necessary for the "Massachusetts" to smash up $60,000 worth of her bottom to convince us that Diamond Shoal was a reality, and not a fiction—a few fathoms of sounding line would have done that; and if there are sunken wrecks encumbering the channels of New York Harbor, it is surely a doubtful policy to use the bottom of the "Brooklyn" as a dragnet to determine their whereabouts.

We know nothing in all the river and harbor work of the War Department that compares in urgency with this problem of the approaches to the Brooklyn navy yard, and how it should come to be thus neglected is a mystery. Just beyond Governor's Island, skirting the Brooklyn water front, a channel 1,500 feet wide and 40 feet deep is to be constructed along the front of a series of docks into which a 25-foot draught ship will rarely enter; yet the ships of the navy are allowed to pass to and fro in peril for the want of a little dredging which would cost not a tithe of the millions that are to be spent on the above-named work.

WHAT POOR ROADS COST OUR FARMERS.

If ever there were two classes of people that had a good cause in common they are the bicyclists and the farmers. The question on which their interests agree is that of the need for good roads; for while a hard, smooth surface is an absolute necessity to the wheelman, it is of even more vital importance to the farmer, seeing that the condition of the roads makes a serious difference one way or the other in his yearly profits. As the result of an inquiry made in 1895 by the United States Department of Agriculture, replies were received from over 1,200 counties giving the cost of hauling crops in various parts of the United States. The average load hauled was found to be 2,002 pounds; the average length of haul, $12\frac{1}{10}$ miles; the average cost of hauling a ton of crops to market was $3.02; while the average cost of hauling a ton for a distance of one mile was 25 cents.

In order to compare the roads of the United States with those of Europe the bureau through its consuls made careful inquiry on the subject of cost of hauling in England, France, Germany, Belgium, Italy, and Switzerland. The average cost of hauling one ton one mile was found to be in England 10 cents, in France 10 cents, in Germany $8\frac{1}{2}$ cents, in Belgium $9\frac{1}{2}$ cents, in Italy $7\frac{1}{2}$ cents, and in Switzerland from 6 to 8 cents, the average for all these European states being $8\frac{6}{10}$ cents per ton per mile. More than one cause may enter into this determination of cost, but that the great cost in America is due to our poorly made dirt roads is proved by the fact that while over the superb roads of Europe a farmer will haul three or four tons at a load, our farmers are able to haul only a ton or less than a ton over the "plow and scraper" ridge of soil which even at this late day is dignified by the name of road in many parts of the country.

THE NEW CANAL COMMISSION.

Bearing in mind the vast interests at stake, we do not hesitate to say that the new canal commission, recently appointed by the President, is the most important engineering commission of modern times. Not only has it to decide whether this country is justified in undertaking a work which is estimated to cost over $130,000,000, and may easily cost 30 or 40 per cent more than that, but its report will determine indirectly whether another important work—the Panama Canal—in which over $156,000,000 has been already expended, shall be completed or abandoned.

It requires no very intimate knowledge of the canal question to prove that only one canal is required at the Isthmus, and that not more than one will be built. It is also evident to any one who is not blinded by national prejudice that a great maritime highway like this should be, and in the very nature of things must be, broadly international in the policy of its administration. As the matter now stands, there are two great rival projects before the public—one two-fifths completed and the other not yet commenced. Each has features to recommend it, although engineering, commercial, and military considerations point strongly to the completion of the Panama Canal as the most feasible scheme.

Although the present commission has been appointed for the ostensible purpose of examining all routes that are plausible, it is well understood that its chief duty is to determine which of the two routes, Nicaragua or Panama, has most to commend it to the active support of the United States government. To assist it in this work it will find a vast amount of engineering data ready to hand. At Nicaragua, in addition to the early surveys of Childs and Lull, it will have the Menocal surveys and those of the Ludlow and Walker commissions. At Panama it will find a complete set of surveys, plans, observations, etc., in such shape as to allow of active construction being undertaken at brief notice.

The commission includes Admiral Walker, Prof. Haupt, and Col. Hains, the former commission; Alfred Noble, of the Ludlow commission; two additional engineers, viz., Lieut.-Col. Oswald H. Ernst, of the United States Army, and George S. Morison, a former President of the Society of Civil Engineers; Prof. Wm. H. Burr of Columbia and Prof. Emory R. Johnson of Pennsylvania and Senator Pasco of Florida. There are thus two engineers from the army, three from civil life, two college professors, a senator and an admiral of the navy. One million dollars has been appropriated to cover the expenses of the investigation, which, all things considered, should be of such a character as to settle the question, as far as the United States is concerned, once and forever.

COMMERCIAL VALUE OF WIRELESS TELEGRAPHY.

A striking evidence of the growth of scientific knowledge and the fidelity with which the scientific press safeguards the public against glaring scientific falsehood, is found in the recent attempt to produce a panic among the shareholders in telegraph and cable companies on account of the success of wireless telegraphy. It was otherwise twenty years ago, when the extravagant claims put forth for electric lighting caused the holders of gas shares to dispose of their valuable holdings. In vain did the scientific press urge moderation, pointing out that the cost and difficulties of the new system of illumination would prevent it from driving out gas lighting—at least for some years to come.

Remarkable as have been the results obtained with wireless telegraphy across the English Channel, there is nothing to warrant the belief that wire telegraphy is doomed. There is one radical difficulty which, alone, is sufficient to restrict wireless telegraphy, at least in the present stage of its development, to a very limited range of practical application. We refer to the fact that no means has yet been devised by which the wireless messages can be directed exclusively to the station for which they are intended. Before wireless telegraphy can be used for general commercial purposes some method must be devised whereby, as in wire telegraphy, the transmitter can communicate with one particular receiver to the exclusion of all others, and the receiver can exclude all messages except the particular one directed to it. Until this is achieved the new system must be barred from the field of ordinary commercial work.

A limitation affecting long distance telegraphy is also found in the fact that the length of the vertical rod has a definite relation to the distance through which the message is sent, and as the mast used in the channel experiments, where the distance was 30 miles, was 177 feet high, it can be seen that this consideration also imposes a limit upon wireless telegraphy. Marconi has recently stated that the present limit of distance over which messages can be sent is about 80 miles; evidently then the problem of trans-ocean telegraphy by this system is far from solution. As a matter of fact, the inventor, with his characteristic modesty, has refrained from making any claims for his system except along those lines in which he has clearly demonstrated its usefulness. The most valuable application of the system is that which was successfully tested at the South Foreland, England, where now for some time wireless telegraphy has been in successful operation between the shore and the lightship. It has been proved that the apparatus is not affected by wind or weather, and we now know beyond question that it is possible to give infallible and early warning to shipping of the presence of dangerous shoals.

MUNICIPAL BATHING ESTABLISHMENTS.

In the United States too little attention is paid to the individual comfort of its citizens. Everything is done for their safety, but in many little ways we are still far behind our transatlantic brethren. One of our greatest municipal defects is the lack of public baths. It is not necessary to dwell upon the need for public baths among all civilized peoples, the virtue of water and soap is conceded. Unfortunately, among the poorer classes it is not always possible for them to obtain adequate bathing facilities in the densely populated districts in which they live. Public baths properly constructed and handled form one of the most effective and far-reaching of municipal institutions for the promotion of cleanliness, good health and good citizenship. Boston, Mass., is a notable exception to the average American city as regards the bathing facilities which this city furnishes to her inhabitants. The experiments of Boston are highly instructive to all cities looking to civic development in the direction of ministering to the practical and essential needs of a community. Public baths in Boston date from 1866, and these were, we believe, the first public baths to be established by a municipality in this country. At first provision was made for a system of baths distributed at various points on the long shore line rather than for a few central establishments according to the British plan. Five floating baths were constructed at that time, and the general type was a low wooden building supported on a floating platform. Within each was a shallow tank through which the water flowed freely, air and light being admitted through the roof. The usual dressing rooms, etc., were provided. These proved so satisfactory that now there are ten of these floating baths.

In 1898 the number of bathing establishments was raised to twenty-three and there were 2,000,000 bathers, an increase of one and one-quarter millions over the previous year. New styles of floating baths have been devised in which the tank is left open to the sky and the capacity of one of them is 1,200 to 1,500 persons per day. In addition to the floating baths two swimming pools were established to supply the wants of the population which lives in the center of Boston. One of them is located in the small park contiguous to the tenement district of Roxbury, fresh water being supplied to the tanks by the city water works, 80,000 to 90,000 gallons being used per day, and from 1,200 to 1,500 patrons daily attend this bath. Men are allowed to bathe in the early morning and evening, the boys in the forenoon and girls and women in the afternoon. That a pool of this kind is not necessarily an expensive luxury will be seen when it is said that it cost only $2,000 to complete it.

The most important of Boston's beach baths is at the North End Park, which, with its pleasure piers and improvements, cost the city $350,000. Frequently 5,000 people bathe per day at this point. The baths which we have mentioned so far are, of course, restricted to summer use; but a new public bath house, open all the year around, will be opened on June 15. The building is most substantial and is thoroughly fireproof. Separate bath rooms for men and women are provided on the second floor, and ample waiting rooms occupy the first floor. The men's rooms are provided with thirty inclosed shower baths and three inclosed tubs, while the women have eleven shower baths and six bathing cabinets. Each shower cabinet contains a dressing alcove and seat. All the partitions are of marble and the fittings are of the latest sanitary type, and the bather can regulate the temperature of the water flowing from the spray as desired. The tubs are of heavy white porcelain, with nickel-plated fittings, and it is doubtful if there is any more real comfort to be obtained in the luxurious bath rooms of the Back Bay district.

In the practical working of the entire system in Boston, fatalities are practically unknown. Swimming instruction is given to thousands and remedies are provided for use in case of cramps or other illnesses. In

order to connect the baths more closely with the city schools, the head swimming instructor visits the public educational institutions before the close of the school year and teaches the children the motions of swimming. The aim in Boston has been to dignify the practice of bathing and to furnish an innocent recreation and to cause the people to regard bathing establishments as necessary to their well-being as the water supply, school house, library, or parks. The course of Boston in this matter cannot be commended too warmly, and the object lesson is of great value outside of the immediate advantage to her citizens.

CALIFORNIA OLIVE INDUSTRY.

The olive is one of the oldest known fruits. It is noted by Pliny and is frequently mentioned in the Bible, where it forms the basis of many parables and figures of speech. In Grecian mythology the olive tree occupies an important place, and to-day the "olive branch" is the world symbol for peace. The olive tree itself is rather melancholy in appearance, but the eye soon becomes accustomed to the tone which the olive trees give to the landscape, and in nearly all of the Mediterranean countries they are found almost everywhere. In general, the olive will flourish wherever the vine can be cultivated for wine-growing purposes. It will not bear a temperature below 21° or 22° F., and in Europe it cannot be grown above 46° latitude. The young plants and fruit are very delicate, but the tree itself is quite tough. Naturally, in Italy, where the olive forms one of the principal agricultural products and contributes so largely to the wealth of the country, the trees are cultivated with the greatest care. The kernel of the olive requires about two years to germinate naturally, but it is found by mixing clay and goat manure nature's processes can be hastened so that it will germinate the same year. The trees attain great age, and a large olive tree near Nice is believed to be a thousand years old and is said to have yielded 500 pounds of oil in a single year.

The culture of the olive in the United States is increasing rapidly, and in California the industry has attained such proportions that already $500,000 is invested in it. Olives were first introduced into the State by the Franciscan Missions almost a century ago. The oldest olive trees in Califoria date from the last century. They are six in number and are stationed at the San Gabriel Mission and are still bearing fruit and are a living monument to the wisdom of the Franciscan Brothers. According to some authorities, the oldest tree is at the Capistrano Mission, thirty miles south of Los Angeles. The seed from which this tree was grown came from Corsica in 1769. It is now 50 feet high and the trunk is at least 5 feet in diameter. The old trees at the Missions are as robust and thrifty as when they first commenced bearing fruit. The Franciscans raised most of their trees from cuttings which they brought from Spain. They found the soil and surroundings most congenial for olive raising, and that the trees flourished even better than on their native soil. The oil enabled the exile of the Fathers to be more supportable by supplying one of the accustomed luxuries of their far-away homes in distant Castile.

The modern history of the California olive culture began about twenty years ago, when the Hon. Ellwood Cooper, of Santa Barbara, who is regarded as the father of the industry, began his investigations on raising the olive as a commercial possibility. He first secured cuttings from the trees of the old Mission and set out a number of olive orchards in Santa Barbara and other places. The result has amply justified his venture. Now there is hardly a part of the State that has not its olive orchard. The olive seems to thrive best under the influence of sea breezes. It takes to almost any character of soil where the drainage is good and flourishes in the localities beyond the range of very heavy frosts. The tree does not require a great deal of attention, and does not resent neglect. The care of an olive orchard is less than for almost any other kind of fruit. The trees are highly symmetrical when grown, and on some ranges are planted along the roadside for the shade and the added beauty which they afford to the landscape. Olives are almost never raised from the seed, as this requires a long time. They are usually raised from cuttings, and have been produced by Mr. Cooper in the fourth year, and a good crop in seven years; 122 pounds is the average per tree. The method of propagation requires constant attention and great experience, but the plants are grown on such an enormous scale the cost of them is very small. In the spring, after the cuttings are rooted, they are transferred to olive-growing nurseries, where they become trees of from three to five feet high in from twelve to eighteen months.

In California opinions are much at variance regarding the variety of olive to grow. Formerly the Mission was the only olive planted. In recent years many different varieties have been brought from Europe. Different locations may require different varieties, but above all other considerations is the quality of the oil produced. The varieties that make the best oil should be selected in all cases, provided that quantity is a fair average to a given acreage planted. This rule is also applicable as well for pickling unless the fruit is too small for economic handling.

Mr. Cooper has trees twelve to fifteen years old which yield 250 pounds of olives, but they do not bear every year. It is estimated that there are now no less than 24,223 acres of olive trees in California, with 1,162,739 trees, of which half are now bearing. The soil must be occasionally cultivated and the trees must be pruned and sprayed to exterminate numerous insects. The greatest drawback to the successful cultivation of the olive is the black scale.

Olive oil making is a simple process; the quality depends on the care exercised from the picking of the fruit through every stage of manufacture until it is put into bottles and corked. About 8½ pounds of olives are required to a large bottle of oil. The fruit is gathered later in the season than other crops, and in the best orchards the olives are plucked one by one from the branches and not shaken from the trees or allowed to drop. Special ladders mounted on wheels are run among the branches of the trees, and the pickers ascend the ladders and pluck the olives, which they drop into a specially made device, usually of tin, strapped about the waist, and which is adapted to hold a considerable amount of fruit.

The olives must not be allowed to stand in heaps, in sacks or any sort of package long enough to heat through, otherwise the oil will become musty and rancid. Absolute cleanliness is required in every step of the process. The olives are first dried, during which process they lose about half of their weight; they are then crushed by a heavy stone rolling over them, and are next pressed the same as in cider making. The first expression is what is known as the "virgin" oil; the lower grades follow in succession. There are at least a dozen oil mills in the State of California.

A considerable part of the olive oil imported is adulterated by cotton seed and other oils, but now with the splendid olive oil made in California there should be no difficulty in getting the pure article in any part of the United States. It is a mistake to believe, however, that absolutely pure olive oil made in Southern Europe cannot be purchased here. It is expensive, but it can be bought; but the ordinary olive oil bought of grocers is apt to be adulterated, if it is not entirely fictitious. Large quantities of olives are pickled in California and are shipped in bottles or small barrels.

The olive industry is an example of what may be accomplished in the way of introducing a new agricultural pursuit in the splendid Southwest.

THE WORLD'S COAL PRODUCTION.

The coal production and consumption of the world during the past fifteen years are presented in some tables just prepared by the Treasury Bureau of Statistics. These show that while the United Kingdom is still the largest coal producer of the world, the United States is a close second, and if the present rate of gain is continued, will soon become the leading coal-producing country of the world. The coal production of the United Kingdom in 1897 was 202,000,000 tons; that of the United States, 179,000,000 tons; Germany, 91,000,000; France, 30,000,000; Belgium, 22,000,000; Austria-Hungary, 12,000,000; Russia, nearly 10,000,000; Australasia, nearly 5,000,000; Japan, over 5,000,000; British India, 4,000,000; Canada, nearly 4,000,000; and Spain, 2,000,000, while no other country reached 1,000,000 tons in production. The United States, however, has gained much more rapidly during the fifteen years under consideration than has the United Kingdom, or, indeed, any of the important coal-producing countries of the world, her gain during the fifteen years being over 73 per cent and that of the United Kingdom less than 24 per cent. The announcement just made by the Geological Survey that the coal product of the United States in 1898 was 219,836,000 short tons against 226,287,000 for Great Britain shows that the United States is rapidly gaining upon that country as a coal producer, and will soon become the leading coal-producing nation of the world.

As an exporter of coal, however, the United States takes low rank in proportion to its production, and stands fourth in the list of coal-exporting countries. In 1897, the exportations of coal from the United Kingdom were 48,000,000 tons; from Germany, 12,000,000 tons; from Belgium, over 6,000,000; and from the United States, a little less than 4,000,000, though in 1898 the quantity exported was slightly above 4,000,000 tons. Australasia comes next to the United States as a coal-exporting country, her exports amounting to nearly 3,000,000, tons, while France exported about 2,500,000, Japan 2,000,000, and Canada about 1,250,000 tons in 1897.

France is the largest coal-importing country, her importations in 1897 being nearly 12,000,000 tons, while Germany imported 6,000,000; Austria-Hungary, 5,600,000; Italy, 4,250,000; Canada, nearly 4,000,000; Belgium, nearly 3,000,000; Russia, 2,500,000; Sweden, over 2,250,000; the United States, nearly 1,500,000; and Australasia, 1,000,000 tons, while no other country imported as much as 1,000,000 tons.

Great Britain is also the largest consumer of coal in proportion to population, her coal consumption in 1897 being 3·87 tons per capita, that of Belgium 2·70 tons, the United States 2·42, Germany 1·58, Canada 1·25, France 0·98, Australasia 0·97, Sweden 0·50, Austria-Hungary 0·37, Spain 0·19, Italy 0·13, Russia 0·09, and Japan 0·07 of a ton per capita.

According to these figures, which are summarized from a report of the production of the principal countries of the world, just issued by the British government, the United States now produces about 30 per cent of the coal of the world, the coal production of the fourteen countries enumerated being in 1897, 566,000,000 tons, of which the United States produced 179,000,000, while in 1883 she produced but 27 per cent of the total product. The 1898 figures make an even more satisfactory showing for the United States.

THE DEATH OF FRANK THOMSON.

The American railroad is celebrated all over the world on account of the extent of the various lines, and the system and enterprise upon which they are conducted. Successful railway management calls for qualities akin to those of statesmanship, and this must be combined with technical training and business ability of the most exacting kind. Mr. Frank Thomson, of the Pennsylvania Railroad, who died on June 5, was the type of such a railway president. As the head of one of the largest of our systems, he had an opportunity which is given to few men, and he had a faculty for divining public needs before the public itself was aware of the fact. It is to him that we owe the introduction of our present dustless stone roadbeds, our block signals, and the system of prizes for faithfulness and great efficiency. It will readily be seen that the debt of the traveling public to Frank Thomson is very great.

Mr. Thomson was born at Chambersburg, Pennsylvania, in 1841. He entered the Pennsylvania Railroad shops at Altoona at the age of seventeen years, after a rudimentary education in the local schools. In four years at the Altoona shops he mastered all the mechanical principles of railroad engineering. His energy and ability were promptly recognized by the General Superintendent of the road, and when the war broke out, young Thomson was put in charge of the military railroad. He restored the Orange and Alexandria and the Loudon and Hampshire railroads. He also played an important part in the construction of the road across the "Long Bridge," over the Potomac, at Washington. In 1862 he reported for duty on the military route south of Nashville. After his return to Washington he assisted Col. Scott in the transportation of 20,000 men to the relief of the Army of the Cumberland. He enjoyed the rather unique distinction of being called to a Council of War in 1864. When he arrived in Washington, the Council was convened in Stanton's bedroom, where the latter lay sick. The War Secretary said on seeing him, "Is it possible that we waited for three days to get the opinion of that red-headed stripling?" The opinion given by the stripling was so conclusive, however, that the movement projected was not made. In 1864 he was appointed Superintendent of the eastern division of the Pennsylvania road; in 1873 he was made Superintendent of motive power. Soon afterward he became General Manager, and in this capacity he introduced the standard track, solid roadbed, the system of track inspection and the award of prizes for the best sections of track. He was a good disciplinarian, and the high grade of efficiency for which the Pennsylvania Railroad is noted is largely due to him. In 1882 he became the second Vice-President, and in 1897 he succeeded George B. Roberts as President of the road.

Mr. Thomson was a splendid example of what a bright young man can accomplish in America provided he has reasonable opportunities for the display of his talent.

TRADE WITH CUBA AND OUR NEW POSSESSIONS.

American producers are already finding an enlarged market in Cuba, Porto Rico, Hawaii, and the Philippines, as is shown by the figures of the Treasury Bureau of Statistics, which indicate that the exports of the fiscal year, which ends with the present month of June, will show a larger exportation to Hawaii and the Philippines than ever before, and larger to Cuba and Porto Rico than in any previous year, except those in which the reciprocity features of the McKinley law were in operation.

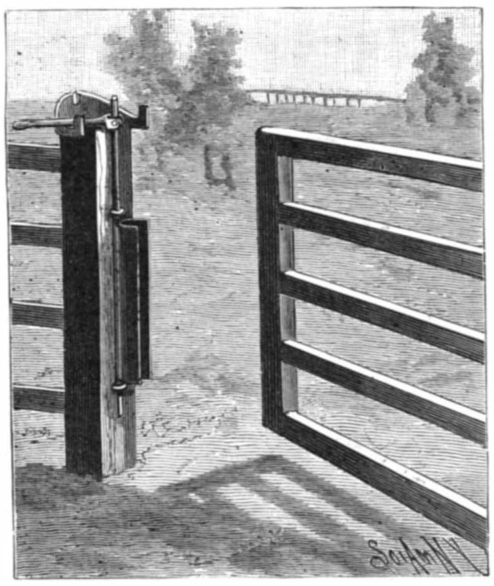
The total exports to Cuba, Porto Rico, Hawaii, and the Philippines in the full fiscal year will be about $30,000,000, against $17,000,000 last year. Our sales to these islands for the fiscal year 1899, even under the unsettled conditions which have prevailed in most of them, exceed those of any previous year, save those of 1893. Of course, these figures do not include any of the supplies sent by the government to any of its troops in the islands.

It is also interesting to know that the exportations to Spain are approaching their normal conditions; those for the ten months ending with May were $8,000,000, against $10,000,000 for the corresponding months of last year.

A SIMPLE FASTENER FOR GATES.

A patent was recently granted to John F. Marcum and Godfrey Hauenstein, of Olds, Iowa, for a gate-fastening device so constructed that it automatically moves to its locking position as the gate closes.

Swinging on one gate-post is a locking yoke comprising two divergent plates secured to a rock-bar. To the upper end of this gate-post a segment-rack is secured having a notch at its central portion and stops at its ends. The top edge of the rack between the stops is inclined downwardly and outwardly. Pivoted to the



AUTOMATIC GATE-FASTENER.

upper end of the rock-bar is a latch-lever adapted to engage the central notch in the rack to hold the yoke in its locking position.

In opening the gate, the latch-lever is swung up to clear the notch. Then by pushing the gate in either direction the yoke will be rocked to release the gate. At this time the latch-lever will engage one of the stops at the end of the rack.

The gate when being swung to its closing position engages the yoke and automatically swings it to its locking position, the latch-lever being moved into the central notch of the rack.

By inclining the upper edge of the rack, the locking-yoke will be prevented from being swung to its closed position by force of wind or other slight pressure; because the latch-lever will frictionally engage the inclined edge.

AN IMPROVED ACETYLENE GENERATOR.

An efficient acetylene apparatus should neither undergenerate nor overgenerate gas. The carbide and water should be properly brought together, so that a steady flow of gas is obtained without regard to the number of jets in use. The carbide should be so decomposed that the production of heat is avoided; for hot acetylene has not only a low light-value, but its use is needlessly expensive. To meet these requirements, the Pan-American Acetylene Company, of Buffalo, N. Y., have devised an apparatus in which the defects encountered in many gas-machines seem to have been effectually overcome.

The apparatus in question, known as the "Northlight," has bottom water-feed generation, the principle

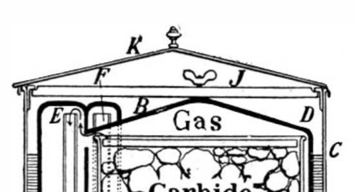


Fig. 2.—SECTION OF THE GENERATOR.

of which is well shown in Fig. 1, representing a miniature generator comprising tumblers inverted in a dish of water. The water in rising within the generator-glass touches the carbide. As soon as the gas thus produced has filled the pipes and apparatus, it forces back the water from the carbide, thereby stopping further generation.

In the actual apparatus, the generator (Fig. 2) consists of an outer casing inclosing a water-sealed gas-bell, *B*, in which there is a peculiar grate (omitted in the engraving) terminating in upward points which support the carbide in a free mass.

The bell, *B*, is formed with sleeves covering the receiving ends of the gas-pipes, *E* and *F*, and of the vent-pipe, *H*. The carbide having been placed upon its grating, water is poured into the outer casing to a certain height. The water in seeking its level rises within the bell, expels the air through the pipe, *H*, and finally comes into contact with the lower edge of the carbide. Gas is immediately generated and is conducted by the pipe, *E*, to the gasometer, and thence throughout the building. The residuum instantly clears itself from the carbide and falls down into the water below. The gas, in passing through the apparatus and distributing pipes then receives a check—assuming that the burners are not in use—and at once begins to push back on the water, forcing it away from the carbide, thus stopping further generation. As acetylene is then consumed at the burners, the pressure within the generator correspondingly decreases, permitting the water to rise again, as at first, into contact with the carbide to generate a fresh supply of gas. It is therefore evident that the generation is controlled merely by the pressure of the gas upon the water, the one acting automatically upon the other. The auxiliary gas-pipe, *F*, leading to the gasometer, is used only when the pressure is so great that the water is forced down below a secondary opening.

The various pipes shown on the exterior of the apparatus (Fig. 3) connect the generator with the gasometer, and comprise a system of traps or water-seals which prevent a back-flow of the gas.

In this apparatus it will be observed that a very small quantity of carbide is made to touch a very large sheet of water. The gas generated is therefore cool. It will be furthermore observed that the carbide is not surrounded by a mass of viscid, slaked lime, thereby preventing that imprisonment of the heat which forms so objectionable a feature in many machines. Incidentally, the fact that the generating chamber is surrounded by a belt of cool water further guards against the production of unnecessary heat. The value of the coolest possible generation is now recognized by

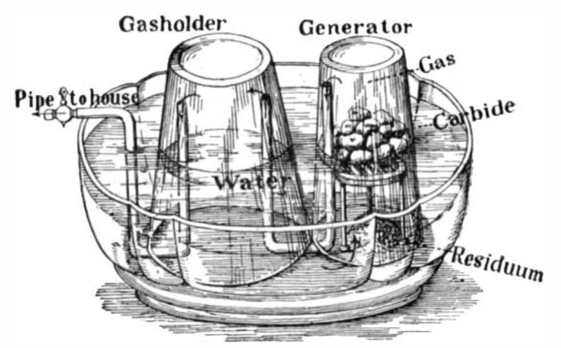


Fig. 1.—A MINIATURE BOTTOM-WATER FEED APPARATUS.

all authorities on acetylene, as heat causes the polymerization of the gas atoms with loss of lighting power.

The merits of the apparatus described earned for it the only gold medal for acetylene machines at the Trans-Mississippi Exposition.

AN AIR-CUSHION FLUID-PRESSURE REGULATOR.

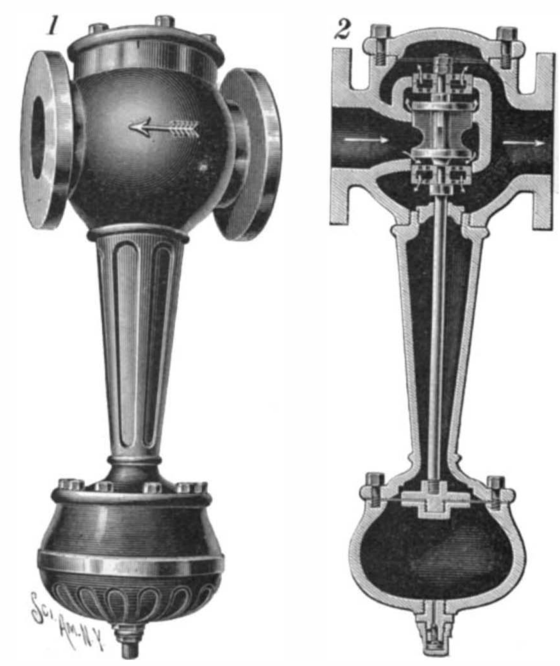
The fluid pressure regulators most commonly in use employ a complicated mechanism composed of weights, levers, or metal springs, to procure the automatic regulation desired. A decided improvement on this form of regulator is to be found in a device made by Julian d'Esté & Company, Boston, Mass., which embodies in its construction a diaphragm acted upon at one side by the fluctuating fluid-pressure, and at the other side by a constant air-pressure.

The regulator consists of a casing, the interior of which is divided into two chambers by a flexible diaphragm. In the lower of these two chambers air is pumped through a convenient nipple, by means of an ordinary bicycle pump, until the desired pressure upon the lower side of the diaphragm is obtained. A spindle is attached to the diaphragm and carries at its upper end a double valve controlling a series of ports through which the fluid (such as steam, water, or the like) flows.

From this construction it follows that at its under side the diaphragm is subjected to a constant yielding air-pressure and at its upper side to the varying pressure of the fluid. When the pressure of the fluid passing through the ports in the upper chamber exceeds that of the air in the lower chamber, the diaphragm is depressed, thus causing the spindle to close the double valve above and to shut off the fluid. When the pressure has decreased and has sunk below that of the air in the lower chamber, the diaphragm will rise, thereby causing the double valve to open the ports which it controls in order to permit the passage of the fluid. The valve, it is evident, can be made to open or close automatically at any desired pressure by varying the pressure of the air in the lower chamber.

The air chamber, if so desired, may be placed in any convenient position and at any distance away, being connected by a pipe with the cover clamping the diaphragm in position. The filling-pipe of the air chamber may be brought down on the wall or supporting column to a convenient point with the fitting (with which the air pump is connected) on the end of it.

When used in libraries, schoolhouses, and office buildings, the air cushion regulator satisfies a want



A SIMPLE PRESSURE REGULATOR.

long felt; for it reduces the high pressure steam now in common use for heating to very low pressure without making any sound whatever.

The Motion of a Perfect Liquid.

At a recent meeting of the Royal Institution Prof. H. S. Hele-Shaw dealt with the subject of "The Motion of a Perfect Liquid," says The Mechanical Engineer. There was no such thing in existence, he explained, as a perfect fluid, and actual liquids differed from it in the possession of several properties, particularly that of viscosity. Yet by virtue of this very property they could be made to flow in the manner of a perfect fluid if inclosed as a thin film between two plates. For this purpose increased viscosity in the liquid was an advantage, because it gave stability; thus the high viscosity of glycerine enabled it to be more effectually controlled than water. By using plates of glass and appropriate coloring matters, the lecturer proceeded to exhibit by the aid of the lantern a series of experiments elucidating the motions of an ideal liquid. He pointed out that the effects actually obtained in this way completely agreed with some of those which mathematical analysis had been able to work out, the films indeed not only affording a striking instance of mathematical prediction, but even offering solutions of problems whose complexity baffled

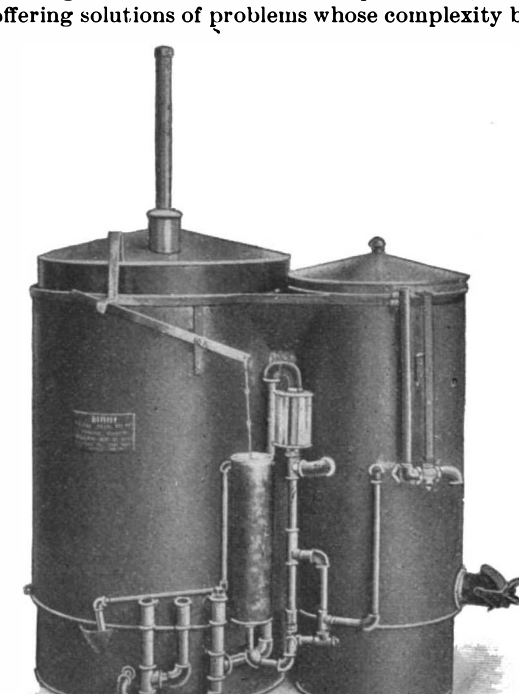


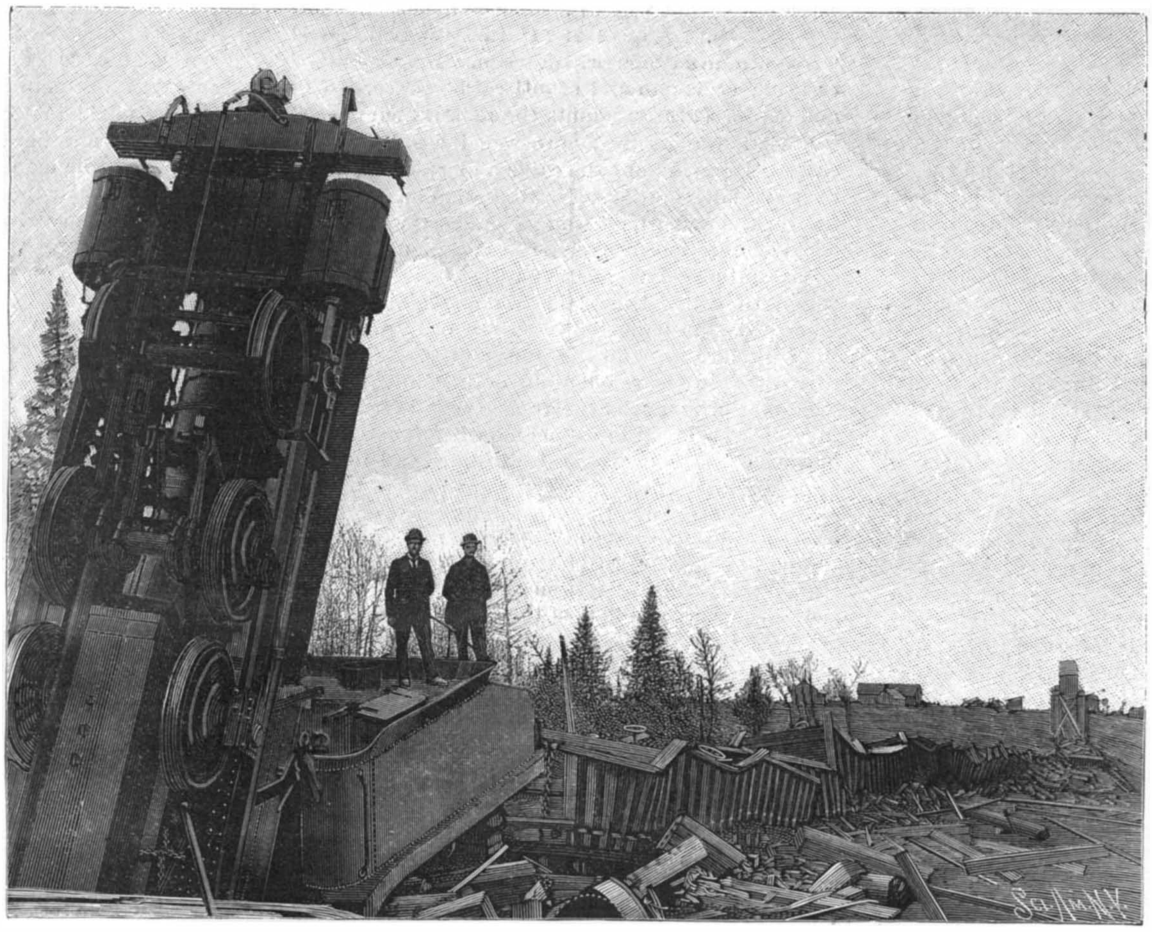
Fig. 3.—THE "NORTHLIGHT" ACETYLENE-GAS GENERATOR.

mathematicians except in a few simple cases. Prof. Hele-Shaw also showed how the liquid could be made to imitate the lines of magnetic and electric induction, and how, by altering the thickness of the film in places, the form of the stream lines could be changed to represent the altered resistance of a magnetic field, due to the presence of a paramagnetic or diamagnetic body.

A REMARKABLE BRIDGE DISASTER.

We present two illustrations of a bridge disaster which recently occurred on the Belt Line branch of the Great Northern Railroad, where it crosses the Nemadji River, near Superior, Wisconsin. The Nemadji at this point flows through a shallow valley over which the railroad is carried at an elevation of about from 50 to 60 feet above the river. The crossing itself consists of a single track deck span of the combination type, with timber posts and top chord and steel bottom chord and diagonals. The approach at either end consists of trestle-work of the standard type, with pile foundations, and its whole length from bank to bank is about 1,200 feet, consisting first of 200 feet of trestle, then a combination truss of about 110 feet span followed by about 900 feet of trestle work across the bottom land.

At the time of the accident a heavy ore train, consisting of several fully loaded ore cars, some box cars, a flat car, and a caboose, and drawn by one of the powerful freight engines of the company, was crossing the structure. The whole train with the exception of two box cars, the flat car, and caboose had passed over the river crossing, when the trestle collapsed at a point somewhat to the rear of the engine, and the whole train with the length of supporting trestle beneath it fell over in the direction of the center line of the structure and assumed the remarkable position shown in the two accompanying illustrations. It would appear that the locomotive was well clear of the dangerous point in the structure at the time it gave away, but that it was drawn backward by the weight of the falling train behind it. The tender assumed a fairly upright position, but the locomotive fell cab downward and was left standing on end as shown. The remarkable feature of the accident is that none of the cars and no part of the bridge fell either to the right or left, the whole structure pivoting forward and downward upon its foundation, the cars in many cases remaining upon the rails. The last two box cars, the flat car, and the caboose, remained on the truss above the river, the couplings fortunately breaking and preventing the end of the train from being drawn down into the general wreck.



NEMADJI RIVER TRAIN WRECK—SHOWING FALLEN ENGINE AND TRAIN.

While at first sight it would seem astonishing that the whole train with its supporting trestle should fall symmetrically forward and not as one might expect to either side, a brief study of the wreck as shown in the upper engraving will explain this phenomenon. It will be noticed that the superstructure, that is to say, the longitudinal stringers, cross-ties, and the track, is carried upon vertical "bents," which consist usually of heavy timbers twelve inches square, although in this case they are built up of 6 × 12 inch timbers spliced together. As a rule there are four timbers to each "bent," the two on the inside being generally vertical and those on the outside having a considerable amount of batter or inward inclination from the ground to the top cap, or transverse carrying piece. The supporting timbers are braced at intervals of about 16 feet of their height by horizontal timbers, and they are further "sway-braced" by diagonal 4 × 12 inch timbers, all the sticks at every point of intersection being firmly bolted together. Upon the ground each bent is carried upon a transverse 12 × 12 inch timber which either rests upon short pieces 6 × 12 inches by 3 feet in length, or is carried upon piles which are driven to a firm bearing in the ground.

It will be noticed that this construction, while it provides ample strength for carrying a vertical load and remarkable lateral rigidity insuring safety against overturning, depends for longitudinal stability mainly upon the superstructure, that is, the stringers, ties, and track; so that should the superstructure be broken through at any point, there is nothing to prevent the whole system of vertical bents from pivoting forward like a line of child's building blocks, and falling upon one another. As long as the superstructure remains intact, the longitudinal forces acting upon the bridge, such, for instance, as the forward thrust resulting from a sudden application of the brakes of a train, are transmitted through the floor system to the opposite abutment; but it is evident that a break at any point in the continuity of the floor imperils the stability in a longitudinal direction of the whole trestle, even if it should happen to be some thousands of feet in length.

The proper safeguard against an accident of this kind is to introduce longitudinal diagonal bracing, extending from the caps of the bents immediately below the floor system, down to the foundations. It is not necessary to insert these braces at every bent, for if they were introduced, say, at every fourth or sixth bent, the collapse of a portion of the bridge would be limited in its destructive effect to a certain stated length of the trestle, instead of, as now, involving the collapse of the whole structure. It will be noticed that in the case of the Nemadji bridge the wreck of the trestle to the rear of the train was prevented by the existence of the truss bridge across the river, whose piers, coupled with the inertia of the truss itself, offered sufficient resistance to longitudinal overturning.

NEMADJI RIVER TRAIN WRECK—LOOKING FORWARD FROM REAR OF TRAIN.

The Fall of Meteorites in British Central Africa.

A fine collection of meteorites has just been added to the Department of Minerals in the British Museum. It consists of four stones which were seen to fall on January 25 in the native villages on the eastern slopes of Mount Zombo, British Central Africa. Two of them weighed 14 and 17 ounces respectively and the other two 29 and 19 ounces. At Zomba a crash like thunder was heard and the reverberations lasted for a few minutes afterward and the detonation was heard at a place 90 miles distant. At one of the new villages the people were found squatting around the stone in a circle discussing the "miracle" as they termed it. None would approach the stone and it was still lying where it fell when the officials arrived. As far as it is at present known, the area over which the Zomba stones fell represented 9 miles long and about 3 miles wide. It is probable the larger number of stones may have reached the earth.

To Move Buildings in Budapest.

A Chicago company is to undertake modern building moving methods in Europe. This company has closed contracts for changing the location of nine structures in the city of Budapest, Hungary, where grading and reconstruction of the street system have been found necessary. The American system of building removal was unknown, but the government engineers began investigations which ended in American engineers being asked to bid on the moving of public and other structures.

The Proper Reading Distance.

At a distance of several meters or yards, says Dr. Norburne B. Jenkins in The Medical Record, little or no muscular effort is required for the normal eye to see objects distinctly; but an extreme exertion of the ciliary muscle, which controls the crystalline lens, is necessary if the vision be directed to an object a few centimeters or half-inches distant from the eye. The following may illustrate the work of the muscles of the eye in reading at several distances: A sheet of paper about twenty centimeters (eight inches) square, printed with type sufficiently large to be easily read at five or six meters or yards, is placed at this distance from a person with normal or emmetropic eyes. Practically no contraction of the muscles of convergence or of the ciliary muscles is necessary in order to read the type. Should the paper be placed a meter or yard from the eyes, the ciliary muscles and the muscles controlling the motions of the eyeballs are called upon for additional work, but no inconvenience is occasioned to emmetropic eyes by prolonged vision at this distance. If the paper now be placed within a few centimeters or half-inches of the eyes, the ciliary muscles contract to their utmost. The internal recti likewise are in a state of extreme exertion in accomplishing the convergence necessary in order that both eyes may see the same type at the same instant. The muscles are no longer adequate to the increased tension. They become exhausted and vision is embarrassed. The type is alternately blurred and distinct, in consequence of the alternate failure and recovery of the muscles. Should this process continue for many minutes, pain and vertigo come on, and the sufferer is forced to direct his vision from the paper. The nearer objects approach the eyes, the greater will be the necessary muscular effort and the sooner will the muscles refuse to perform their functions; the farther the type is held from the eyes, the less is the requisite muscular effort; hence it is probable that the farthest point at which distinct reading-vision is possible is the proper distance for continuous reading. Probably this point is more than thirty-five centimeters (fourteen inches) distant from the eyes, and is dependent upon the strength of the muscles, habit, and the visual acuity.

The Development of Submarine Telegraphs.

The development of the submarine telegraph from a mere gutta percha coated wire laid in New York Harbor by Prof. Morse in 1842 to the great cables which now engirdle the entire earth except the bed of the Pacific is described in a statement just issued by the Treasury Bureau of Statistics, entitled "Chronology of Submarine Telegraph Construction throughout the World, and the Development of Submarine Telegraphy." This publication, which has been prepared by the Bureau of Statistics in view of the special interest just now developed in a submarine telegraph line to connect the United States with Hawaii, Guam, the Philippines, and the Asiatic coast, shows not only the location, number, and length of the submarine telegraphs of the world, but also the history of this great system and the part which American genius and enterprise have had in its development.

The statement credits Salva, a Spaniard, with the first recorded suggestion of submarine telegraphy, made before the Barcelona Academy of Sciences in 1795. Aldini, a nephew of Galvani, performed experiments in the transmission of electric signals under the sea near Calais, France, in 1803; Schilling ignited gunpowder by electricity transmitted through a subaqueous conducting wire under the Neva River near St. Petersburg in 1812; telegraph signals were transmitted through insulated wires under the River Hugli, in India, by the director of the East India Company's telegraph system in 1839; and in 1842 Prof. Morse transmitted electric currents and signals through an insulated copper wire laid for that purpose between Castle Garden and Governor's Island in New York Harbor, and in the following year suggested submarine electric communication between the United States and Europe. In 1845 Ezra Cornell, in conjunction with Prof. Morse, laid and successfully operated submarine copper wires in the Hudson River between New York and Fort Lee, and in 1847 a section of the telegraph line connecting New York and Washington was laid through the waters of a narrow creek by J. J. Craven, of New Jersey, thus demonstrating the practicability of actual submarine telegraphic service. In 1850 a submarine telegraph line was laid across the English Channel and signals exchanged, but without further success, though in the following year a cable containing four copper wires insulated with gutta percha and protected by galvanized iron wires wound spirally about it was laid across the English Channel and put into successful operation as a submarine telegraph line.

These experiments having proved the practicability of submarine telegraphy, the great enterprise of a telegraph line under the Atlantic Ocean was undertaken, and the subsequent developments are described in the statement as follows:

1857. First attempt to lay a submarine telegraphic cable across the Atlantic Ocean, the enterprise being headed by Cyrus W. Field, of New York, and Charles Bright, J. W. Brett and others, of England. The cable was to extend from Valentia, Ireland, to Newfoundland, the length of cable necessary being estimated at 2,500 miles. The construction of this cable was similar to that across the English Channel. After 255 miles had been laid from Valentia westward, the cable broke and the work was abandoned.

1858. Renewal by Mr. Field and his associates of the attempt to lay a submarine telegraphic cable across the Atlantic. The United States naval vessel "Niagara" and the British vessel "Agamemnon," carrying each one-half of the cable, proceeded to mid-ocean, and after joining the ends of their respective sections, on July 29, proceeded westward and eastward, paying out the cable and reaching their respective destinations, Newfoundland and Valentia, on the same day, August 5, 1858, when electrical connection between the continents was at once established over 2,050 nautical miles of cable which they had thus laid. Congratulatory messages were exchanged between the President of the United States and the Queen of England, and there was public rejoicing in both countries over what was pronounced the great event of the century. After less than one month of operation, however, the cable ceased working and it was never operated further, nor was any part of it ever recovered. During the time of its operation, 730 messages of about 10,000 words were passed over it. Its total cost was $1,256,250.

1859. A submarine telegraphic cable to connect England with British India was laid through the Red Sea and Arabian Sea to Kurrachee, India, having a total length of 3,043 nautical miles, but with several intermediate landings. Some portions of the line worked satisfactorily for thirty days, but few if any messages were sent over the entire length, and it soon proved a complete failure.

1860. Elaborate study of the entire subject of submarine telegraphs and the construction of cables was made by a committee appointed by the British Board of Trade, resulting in an expression of the belief that submarine telegraphy might, despite past failures, become successful and profitable if sufficient care were exercised in constructing, laying, and managing the cable.

1861. A submarine telegraphic cable, which had been manufactured with great care, was laid across the Mediterranean from Malta to Alexandria, Egypt, with intermediate landing places at Tripoli and Benghazi. The cable consisted of seven copper wires stranded together, covered with several coatings of gutta percha alternated with other non-conducting and waterproof material, and in turn covered and protected by eighteen iron wires wound spirally about this core. This cable proved a permanent success and went into general operation shortly after its construction. The speed of transmission, which on the Atlantic cable and shorter submarine lines had been three words per minute, was brought up to ten words per minute on each separate section, but was only three words per minute when all the sections were united and operated as a single line of 1,331 miles.

1862. A submarine cable which had been laid across the Mediterranean Sea between France and Algeria in 1861 proved a complete failure after a few months of experiment.

1864. Construction of a cable line to connect India with England undertaken by the Indian government, the line to be laid through the Arabian Sea and Persian Gulf to connect with land lines, thence to Calais, and by the short submarine line under the British Channel to England. The submerged line in the Arabian Sea and the Persian Gulf had a total length of 1,450 miles, but with three intermediate landing places. This line consisted of a copper core surrounded by layers of gutta percha, alternated with other non-conducting and waterproof material, being protected by an outer sheathing of twelve galvanized iron wires wound spirally about it, which in turn were protected by double wrappings of tarred hemp yarn. All of these materials and the various sections of the cable were constantly and thoroughly tested electrically and otherwise during its construction. The line when laid proved a complete success, becoming the first successful telegraphic connection between England and India.

1865. Another attempt made by Cyrus W. Field, of the United States, and his associates in the United States and England to lay a submarine telegraph cable from Valentia, Ireland, to Newfoundland and the United States. The cable, for which the contract price was $3,000,000, partly in cash and partly in shares of the company, consisted of seven copper wires surrounded by numerous coatings of gutta percha and other waterproof nonconductors. This was in turn surrounded by ten Bessemer steel wires, this being the first use of steel wires for cable protection, each wire being separately wound with pitch-soaked hemp yarn, the shore ends being also further protected by thirty-six heavy iron wires wound spirally about the completed cable. The steamer "Great Eastern," then the largest steamship afloat, was specially fitted up for laying this cable. Great care was exercised in every particular, but, after 1,186 miles had been laid westward from Valentia, the cable broke in water over 11,000 feet deep, and the attempts to recover it were unsuccessful.

1866. Mr. Field and his associates renewed their efforts to lay a cable across the Atlantic. A new company, with $3,000,000 capital, was formed, with the double purpose of attempting to find the end of the cable partially laid in 1865, and complete the line, and also to lay another cable parallel with and near to it. The cable manufactured for the proposed new line was similar to that of 1865. The "Great Eastern" was remodeled to further meet the requirements of the work, and left Valentia, Ireland, July 13, 1866, paying out the cable in a line about 25 miles north of that followed in the preceding year. She safely arrived at Newfoundland in fourteen days from the date of leaving Valentia, and electrical communication was immediately established between the United States and England, which has never since been more than temporarily interrupted. The "Great Eastern" then returned to the spot where the cable was lost in 1865, and, after eighteen days' work, succeeded in bringing the end on board from a depth of over 11,000 feet, the tests immediately made showing it to be in perfect working connection with the Valentia end. A splice was made and the laying of the line toward Newfoundland resumed, and on September 8 the cable was landed at that point and the second successful line of communication between the United States and Europe thus completed, Newfoundland being already in submarine telegraphic communication with the mainland and telegraph systems of the United States. The length between Trinity Bay, Newfoundland, and Valentia, Ireland, is given by the American Cyclopedia at 2,143 miles. The rate of speed in transmission over these cables was at the beginning eight words per minute, but increased to fifteen words per minute.

The success of the 1866 cables so completely demonstrated the practicability of submarine telegraphy that its progress thenceforward was very rapid. A second Anglo-Mediterranean line was laid from Malta to Alexandria in 1868, proving a complete success. A cable between France and Nova Scotia was laid in 1869, and another from Suez to Bombay, India. In 1871 a cable line was laid along the eastern coast of Asia to connect with land lines already constructed across Siberia and Russia. These land lines had been built shortly after the failure of the first Atlantic cable experiment, in the hope of connecting Europe and America by way of Siberia, Behring Straits, Alaska, British America, and the United States; but that plan becoming unnecessary after the success of the 1866 cable experiments, the land line across Russia and Siberia was utilized to connect a cable system of the eastern shore of Asia with the land and cable systems of Europe and America. In 1873 South America was connected by cable with the United States and thence with Europe; in 1875 cables were laid along the coast of Africa, connecting its important points with Europe and America; in 1880 cables were laid across the Gulf of Mexico and along the western coast of South America and connected by an overland line across the Isthmus of Panama. The invasion of the Pacific has been already begun by the construction of lines extending from Australia 1,200 miles southeastwardly to New Zealand and 800 miles northeastwardly to New Caledonia, but leaving the Pacific the one great body of water which has not yet been completely spanned by submarine telegraph wires. This it is believed is now practicable, since the distance between the four landing places now under the control of the United States, Hawaii, Wake Island, Guam, and the Philippines, is in each case less than that through which submarine cables are now being daily operated between France and the United States.

New Field for Fruit Preserving Machinery.

For some time past there has been considerable agitation going on in Jamaica as to the most practical way in which the surplus fruit and vegetables can be preserved for shipment. There is an excellent opportunity for those who have devices for evaporating or preserving fruit and vegetables to patent and introduce their machines into Jamaica and where there must shortly be an extensive demand for them.

Exhibition of Liquefied Hydrogen.

Great interest was exhibited at the Royal Institution, London, on June 7, when Prof. Dewar for the first time exhibited liquefied hydrogen to the public. He delivered a lecture on the subject and showed that the air surrounding the liquid was solidified like snow. Strange to say, cork placed in the liquid sank like a stone.

Correspondence.

Chain and Sprocket Problem.

To the Editor of the SCIENTIFIC AMERICAN:

As the theory of the movement of a bicycle is being gradually introduced into text books on mechanics and discussed in mathematical journals, it is interesting to know whether certain results of mathematical investigation in this direction might be of practical value to the constructor. In this communication no reference shall be made to the dynamical laws governing the motion of a bicycle, but I shall submit for practical consideration the arithmetical solution of a problem which is connected with the sprockets and chain of a bicycle, and which may be stated as follows:

What must be the relation between the number of teeth of the sprockets and the number of links of the chain in order to have a continuous change between the teeth of the sprockets and the links of the chain?

To make the problem clear, consider a tooth A_m of the front sprocket and a tooth B_n of the rear sprocket which are connected with the links a_m and b_n of the chain respectively (m and n designate the orders of the teeth in counting). In a similar manner let A_{m-1}, B_{n-1}, a_{m-1}, b_{n-1} be the teeth and links next to the previous teeth and links in the opposite direction of the motion of the teeth and links. Now let the chain describe a complete revolution. What must be the relation between the number of teeth and links, so that after a complete revolution of the chain the links a_{m-1} and b_{n-1} will be applied to the teeth A_m and B_n respectively? To answer this question let m and n be the number of teeth of the rear and front sprocket respectively, and c the number of links of the chain.

If c is divisible by m and n the problem cannot be solved, since the same link will always be applied to the same tooth. The conditions of the problem are evidently

$$(1) \quad ma + 1 = c$$

$$(2) \quad nb + 1 = c$$

where a and b are two integral numbers to be determined. The co-existence of these conditions gives the required relation—

$$(3) \quad ma = nb, \text{ or } \frac{n}{m} = \frac{a}{b}$$

i. e., the two integral numbers a and b must be proportional to the numbers m and n respectively. As an example, suppose that the front sprocket has 27 and the rear sprocket 9 teeth. Then $\frac{27}{9} = \frac{b}{a} = \frac{6}{2}$, assuming $a = 2$ and $b = 6$, the number of links, according to (1) and (2),

$$c = 27 \cdot 2 + 1 = 9 \cdot 6 + 1 = 55.$$

In this case the gear would be (28-inch wheel)

$$\frac{27}{9} \cdot 28 = 84.$$

During a complete revolution of the chain the front sprocket makes $2\frac{1}{27}$ revolutions and the rear sprocket $6\frac{1}{9}$ revolutions, so that during the second and every successive revolution of the chain every link is applied to a tooth next to the tooth in the previous revolution. A great number of other possibilities and extensions of the original problem might be added, but the foregoing example is sufficient to illustrate its value. The condition implied by equations (1) and (2) is seldom realized in the driving mechanism of a bicycle. Take, for instance, the data of a real case, where $m = 24$, $n = g$ and $C = 56$. It is impossible to find two numbers a and b, so that

$$24 \cdot a + 1 = 56, \text{ and } 9 \cdot b + 1 = 56.$$

The practical advantage of the arrangement of the number of teeth and links, according to the condition named above, seems to lie in the fact that by constant interchanging of teeth and links driving the motion the movement and wearing of sprockets and chain becomes more uniform. It would be interesting to know what practical bicycle builders think of such an improvement, and how much importance they attach to my proposition.

ARNOLD EMCH, Ph.D.,
Professor of Graphic Mathematics.

Kansas State Agricultural College, June 6, 1899.

A Hydrogen Experiment.

To the Editor of the SCIENTIFIC AMERICAN:

In Storer and Lindsay's Elementary Manual of Chemistry, page 43, we find the following experiment:

"Support a rather wide tube of thin glass—the neck of a broken retort, for example—in a vertical position, and connect the upper opening with a gas holder containing hydrogen. Allow the gas to flow until the tube is filled; then apply a lighted match to the mouth of the tube, and regulate the flow of gas so that the latter may continue to burn slowly at the lower edge of the tube.

"With a second gas holder containing oxygen, connect a piece of narrow gas tubing drawn out to a fine point; and, while the oxygen is flowing through this tube, pass it up into the larger tube filled with hydrogen. As the stream of oxygen passes through the burning hydrogen at the bottom of the vertical tube, it takes fire, and afterward continues to burn in the atmosphere of hydrogen within the tube. Care must be taken that no mixture of hydrogen and oxygen shall accidentally accumulate in the tube."

The members of my chemistry class decided to put this matter to a test and determine, if possible, whether it was the oxygen burning in the atmosphere of hydrogen, or whether it was the hydrogen that was really burning while the oxygen supported the combustion. At first a glass tubing was used to convey the oxygen gas into the atmosphere of hydrogen, which appeared precisely as though the oxygen were burning and gave a very yellow flame, due, of course, to the sodium in the glass. Next a platinum tube was substituted for the glass tube and the operation repeated in a darkened room, when a dark zone could be readily distinguished in the center of the flame, surrounded by the typical blue, almost invisible hydrogen flame, which we think proves conclusively that the hydrogen burns around the outside of the escaping oxygen, and that the oxygen furnishes or supports the combustion, and that the oxygen itself does not burn.

CHARLES W. RANDALL, M.S.

[It is usual to call hydrogen a combustible and oxygen a supporter of combustion; but the usage is a convenience simply. Both are consumed in combustion. Neither of these could be set on fire in a gas with which it would not combine. The language of the experiment quoted is much abler than the text book from which our correspondent quotes it. We do not consider the point involved of much practical consequence. —ED.]

He Welcomes the Trusts.

A correspondent of The Age of Steel writes: Among my valued acquaintances here in the East is a gentleman who has the distinction of being a much-sought and reliable public accountant. He is, in fact, one of the most expert in the profession. I met him the other day rushing down Broadway to catch a train. "Busy! Well, I should say so," said he in reply to my salutation. "Run to death by trusts; can't begin to keep up with calls; wish there were fourteen days in each week. Why? I get paid $25 to $50 per day to go through the books of concerns going into trusts, because the trusts won't buy a concern on its own representation of its condition, and I am called in. My charges don't cut any ice in the matter at all; it is a correct statement they want.

"And this isn't the best part of it either, for the capitalization of these trusts represents fully 50 per cent of water. The absolute cash value, shown by my reports, is usually covered by the preferred, guaranteed, dividend-paying bonds, and these bonds are taken by those inside the trusts, and the stock, which is usually all water, is sold to the dear public. Now, it won't take long for the public to get its eye teeth cut, and to wake up to the fact that they have tackled the wrong end of the mule, and that they need not even hope for dividends. Then there will be some high and lofty kicking and an accounting will be demanded, and then I will be again called in. Oh, I tell you these trusts are a great thing, and I catch them both coming and going. But let me tell you something, my dear boy, sub rosa, you know—don't buy any stock in a trust."

Meeting of the Association of Agricultural Chemists.

The Sixteenth Annual Meeting of the Association of Official Agricultural Chemists will be held in San Francisco, Cal., beginning July 5. Arrangements have been perfected by which members will receive substantial reduction on the railroads and at hotels, and interesting excursions have been planned. The agricultural industries of California are of such enormous importance that probably no other locality could be selected which would answer better as a place of meeting. Dr. H. W. Wiley, Chief Chemist of the United States Department of Agriculture, is the Secretary of the Association of Official Agricultural Chemists.

Removal of the Reservoir.

The actual work of tearing down the old reservoir for the New York Library, on Fifth Avenue, between 40th and 42d Streets, was begun on June 7. The debris in the interior of the reservoir, which has not been used for some time, will be first removed, and the destruction of the walls will soon begin. There are 110,000 cubic yards of stone work to be removed. The contractor will receive $105,000 for the removal of the stonework, and the remainder of the $378,000 which the contractor is to receive will be for the construction of the foundation for the new Library.

AN Automobile Show will be opened on June 17, at Richmond, near London, by Prince Edward of Saxe-Weimar. There will be tests of hill climbing and races between fast trotting horses and automobiles. An American company is about to establish a motor carriage factory at Coventry. It is possible that an automobile race will be held between New York and Chicago, between M. Charron, the winner of the French automobile race, and the inventor of the Winton machine.

Science Notes.

A Cincinnati physician has been making practical tests in cigar factories on the eye of the employes. The test is to discover the effect upon the eyes of persons addicted to excessive smoking, also to see what effect the fumes of tobacco in factories have on the sight. He also intends to examine the eyes of letter carriers and others with reference to the effect of smoking on the eyes.

The Sydney, Australia, cycle track has been lighted in a novel way, by means of inverted arc lights. Fifty-five arc lights and seventy incandescents are placed around the track at intervals of thirty-five feet, the lamps being inverted with the reflectors immediately over the arc. There are absolutely no shadows cast, and leading cyclists are of the opinion that it is safer to ride at night under this light than by daylight.

A curious event recently occurred in Oklahoma. The village of Mountain View, Oklahoma, was organized in a day. A rival town existed about a mile and a half west, and it was deemed advisable to consolidate it with Mountain View. The rival, "Oakdale," was purchased entire, for $34,380, and is now being transported to Mountain View. This is probably the first instance where one town was bought out and moved en masse.

In 1854 the "New World" of the People's Line made a record for the run between New York and Albany which has never been equaled, the time being six hours and twenty minutes. The "Adirondack" recently made the trip in six hours and forty-four minutes. The first Hudson River steamer, Fulton's "Clermont," required thirty-two hours to make the run from New York to Albany in 1807. In 1817 the "Chancellor Livingston" made the run in eighteen hours. In 1837 the "Rochester" made a record of ten hours and one minute. In 1860 the "Drew" made the trip in six hours and fifty minutes.

Prof. Moritz has investigated the conditions necessary for the absorption of drugs, and finds that medicaments are absorbed most speedily when taken with plain water while fasting. Soup, milk, wine, etc., retard absorption, even when the medicine is taken fasting, but absorption is still more slow when the medicament is taken with liquid after food, and most slowly of all when taken after food in the absence of liquid. To secure the most speedy absorption of any drug, therefore, it should be administered with water on an empty stomach, and in many cases it will be found that a definite effect will thus be produced, though no effect would be perceptible if the same dose were administered shortly after food.—Münch med. Woch., 45, 1521.

Of late years much attention has been paid to the subject of color blindness among railway employes, but acuteness of hearing has not been equally well observed. The New York Medical Journal quotes Dr. Stein, who has examined forty-four firemen and thirty-eight engine drivers, and finds only three out of the whole number to possess perfectly normal hearing power. He finds, however, by frequent excursions on locomotives that these employes hear sound signals under favorable circumstances, except those of the whistle. Nevertheless, he thinks there should be an established or minimum standard of requirements as to hearing. These views are the result of Continental experiments, and it would be interesting to know what the figures would be as regards the hearing of railway employes in the United States.

"That there is something more serious than the mere wound in the bite even of a healthy animal," says Appleton's Popular Science Monthly, January, "is attested by Mr. Pagin Thornton. . . . 'And what is more surprising to me,' he says, 'is that some of us may have hands crippled for some time from bites of a man's teeth.' Dog bites are always dangerous, but largely from the size of the wound which a dog biting in earnest will inflict. With men they usually fail to do their best. Animals recover from wounds more easily than men do; but Lord Ebrington says that deer bitten by dogs in Exmoor hardly ever recover. Much of the poisoning caused by bites is supposed to be due to the state of the animal's teeth; and in this way the bite of a herbivorous animal, whose teeth are usually soiled, may cause worse after-effects than that of a carnivora, whose wet mouth and wet tongue keep its teeth fairly clean. A similar difference is observable in the effects of being clawed and bitten by carnivora. Wounds made by the claws of leopards are poisonous, while those caused by the teeth are rarely septic. The force with which a bite in earnest is inflicted is an important element in its dangerous character. 'It seems,' says The London Spectator, 'as if for the moment the animal threw all its force into the combination of muscular action which we call a "bite." In most cases the mere shock of impact, as the beast hurls itself on its enemy, is entirely demoralizing, or inflicts physical injury. A muzzled mastiff will hurl a man to the ground in the effort to fasten its teeth in his throat or shoulder. Then the driving and crushing force of the jaw muscles is astonishing.'"

A LARGE STATIC MACHINE FOR X-RAY WORK.

BY FRANCIS H. WILLIAMS, M.D., BOSTON.

There are many forms of apparatus for exciting vacuum tubes to generate X-rays, and doubtless we are soon to have simpler exciters than a large static machine. I planned this one because I felt satisfied that it would answer my purpose in making X-ray examinations in diseases of the chest until a more efficient form of apparatus was devised. I have also a coil which gives a steady light, but is less powerful than this machine.

The machine is in a dark room inclosed in a wooden case, supported two inches above the floor on glass blocks. The case is 8 feet long, 7½ feet high, and 3 feet wide.

Fig. 4 shows my method of making X-ray examinations, the curtain which ordinarily hides the static machine from view being drawn aside to show one end of the machine. Over the patient are two cords, one of which controls a brass rod that short-circuits the machine, throwing the Crookes tube out of the circuit, while the other controls the amount of light. The fluorescent screen on which the X-ray picture is formed is seen on the chest of the patient.

Fig. 2 shows the machine with most of the front of the case removed. The house officer on the right of the picture suggests the proportions of the machine. For convenience, the terminal on the right is extended by a brass rod to a brass ball (hung on a wooden rod) near the middle of the machine; this brings the terminals nearer together. The condensers are covered on the outside on the bottom only.

The machine has four revolving clean plate glass circles 6 feet in diameter and ¼ inch thick and four fixed glass circles 6 feet 4 inches in diameter; it is run by a one horse power motor through a countershaft, and it has a speed controller, which is essential, for by its means the number of revolutions per minute of the plates may be varied from 50 to 275.

A small influence machine, with a single revolving plate, not shown in the figure, 2 feet in diameter, fastened to the inside of the case, is used to excite the larger machine. There are two electric heaters inside the case which may be used if necessary to warm the air when it contains a very large percentage of moisture. These are preferred to the use of chloride of calcium.

The revolving glass plates are attached to the shaft

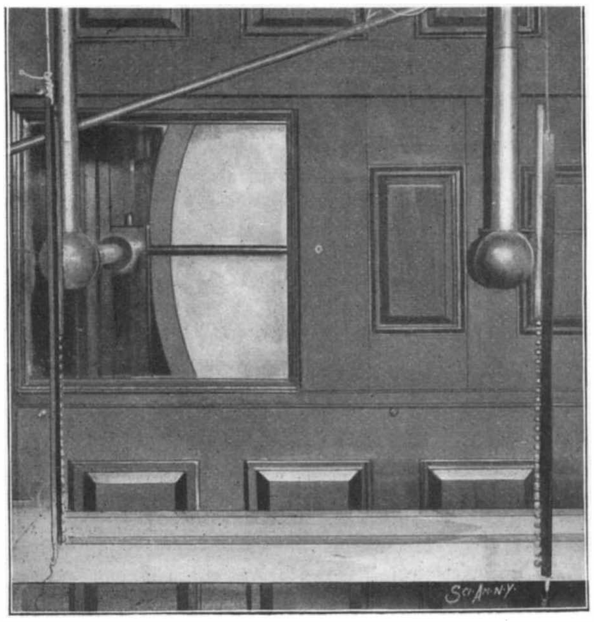


Fig. 1.—DETAILS OF ADJUSTABLE MULTIPLE SPARK-GAP.

by two cast-iron hubs one foot in diameter, each of which is made in three pieces. The center section of each hub is a disk which is loose on the shaft and serves as a separator between the two glass plates; the inner disks, which are contiguous to each other, are fast upon the shaft, while the outer disks are tightened against the glass plates by means of large nuts threaded on the shaft.

Perfect steadiness in the light from the tube is necessary, but when a long spark gap is used the light is unsteady, and this variability makes careful examinations with the fluorescent screen impossible. The long spark gap is also noisy. To overcome the lack of steadiness in the light, I devised what I have called an adjustable multiple spark gap. It consists of hollow brass balls ½ inch in diameter fastened ⅛ of an inch apart along the edge of a ¼ inch strip of vulcanite, Fig. 1, and this strip, with its balls, is free to move up and down through a vertical brass tube, which has a slot ¼ of an inch wide running its whole length; there are two such spark gaps, one on each terminal. When the electricity is turned on, a discharge is seen to go from one small ball to the next. These spark gaps are controlled by the cord seen hanging in the left of the picture, Fig. 4, nearly over the patient's head. By means of this cord, the row of balls and the tubes may be lowered or raised, and thus many or few of the short spark gaps may be brought into the circuit, and, consequently, much or little light be produced. Thus while examining the patient the light may be readily adapted to the needs of the case. This power of regulating the light is of prime importance in examining the heart and lungs. The light may be varied by changing the speed of the machine, but more readily by changing the spark gap, as just described.

The Crookes tube is placed in a closed box in order to prevent its light from brightening the room.

The other cord over the patient is used to raise or lower the brass rod which connects the terminals with the machine, and by this device the Crookes tube is thrown in or out of the circuit and shuts off as soon as the examination is over. The tube should be about three feet away from the patient. A thin screen of aluminum, not shown in the cuts, which should be grounded, should always be placed between the tube and the patient. There need be no fear of any burn, or inconvenience even, from X-ray examinations if simple precautions are taken. In about 3,000 examinations made at the Boston City Hospital I have seen no harmful effects produced.

No account of X-ray apparatus should be given with-

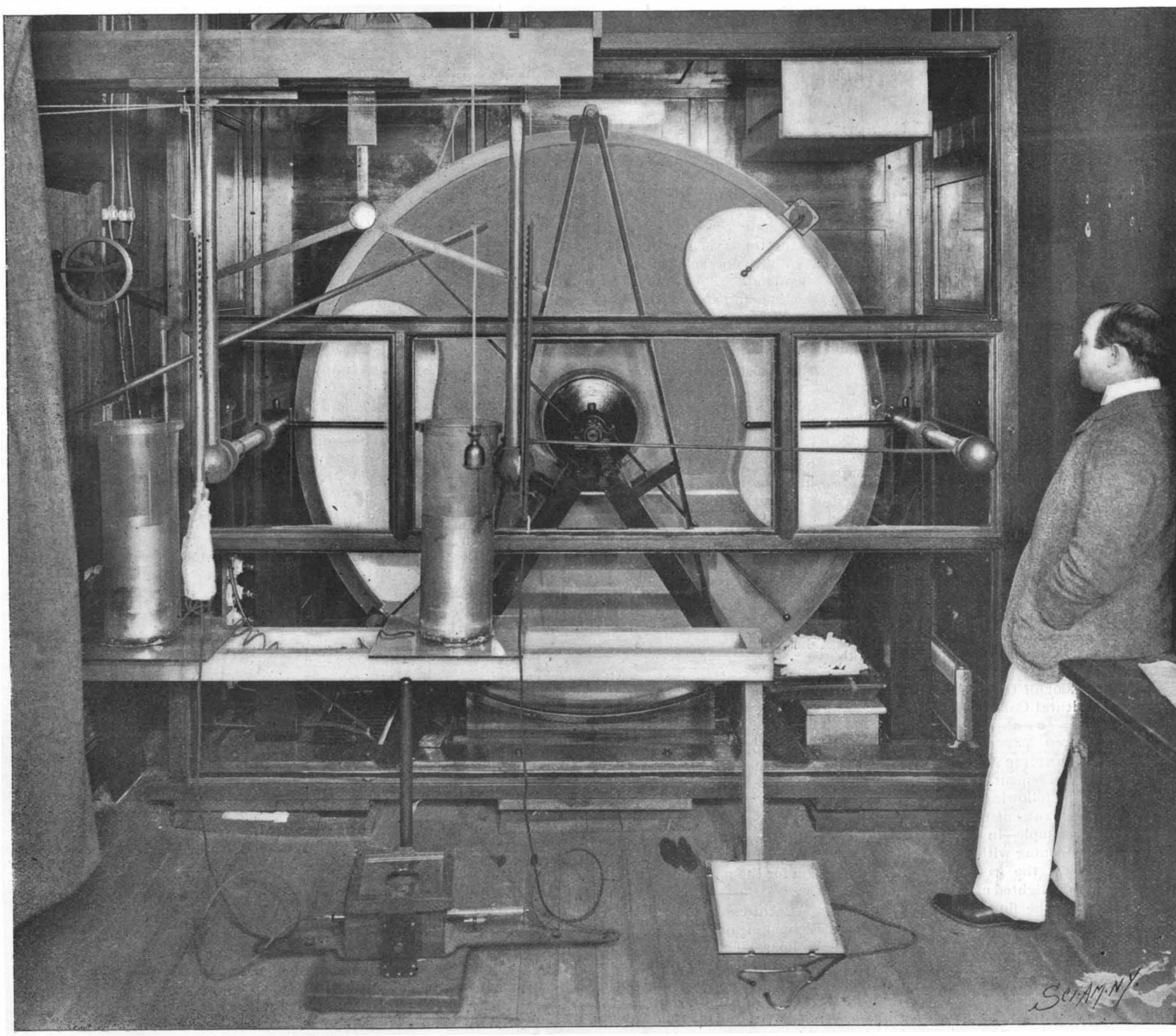


Fig. 2.—MAMMOTH STATIC MACHINE FOR X-RAY WORK.

Diameter of revolving plates, 6 feet; of fixed plates, 6 feet 4 inches.

out referring to the investigations of Dr. William H. Rollins on vacuum tubes. One of the chief obstacles to practical X-ray work has been the inability to control the vacuum in the tube and to lower it when it became too high. This difficulty has been overcome by Dr. Rollins and others.

Three years or more ago, when the X-rays first came into use, it was a question whether pulmonary tuberculosis would give any indications of its presence in any stage. The examination of a few patients soon answered this question in the affirmative, and then the point arose as to how early signs would be obtained by the means of the Roentgen light. Experience has shown that slight abnormality even of the lungs is seen, and that by the aid of the X-rays, together with the usual methods of examination, the diagnosis of pulmonary tuberculosis may be made at an early stage. When we appreciate that in Massachusetts out of ten persons dying between the ages of twenty and thirty-six, six die of consumption, it is evident that this new method of examination will be of value.

There are in the minds of many two misconceptions in regard to the way in which the X-ray assists the physician in pulmonary tuberculosis. The first is that the "germs of consumption" can be seen, and second that they can be killed by the X-rays. We do not see by means of the X-rays the tubercle bacilli; they are microscopic objects which require a lens of very high magnifying power to make them visible, and even then this is only possible after they have been stained with an aniline color. Neither do the rays kill the "germs of consumption," nor, so far as our knowledge goes, have they any action upon them. The advances made by this method of examination are due to the fact that we can in one or both of the following ways, namely, by means of the darkened lung and the shortened excursion of the diaphragm, detect in many cases that the lungs are in an abnormal condition earlier than by other means. To appreciate this point it must be understood in the first place that the lungs in health, being filled with air, allow the X-rays to pass readily and therefore this portion of the chest is bright on the fluorescent screen; but when diseased they become more solid and obstruct the rays, and a shadow of the diseased part is thrown upon the screen. Second, during deep inspiration the diaphragm in health moves up and down through a certain distance; in disease the excursion may be lessened, and this diminished movement is seen upon the screen.

It is of great importance in heart disease to know accurately the size of this organ, and the X-rays give us more exact information on this point than we have hitherto been able to obtain. The heart may be smaller, or, as is more frequently the case, larger than it should be. The enlargement may be the result of inefficient action of the valves or it may be due to quite other causes, but whatever its origin there is nothing more important for the physician to know in many patients than its size, and the X-ray examination, as just stated, enables us to ascertain this more accurately than ever before. When it becomes customary to examine the chest with the X-rays, deaths from heart failure without previous warning will be less common. If the arteries or kidneys are diseased, the size of the heart is affected, and an enlarged heart may therefore suggest these complications. We can not only determine the size of the heart by the rays, but we can also follow its movements in health and disease by these means; and this has not been possible before.

In other diseases of the chest X-ray examinations are of value; for instance, tumors and fluid may be recognized in the chest.

The size and movements of the stomach may be followed under certain conditions, and these examinations may be of service in determining deformities of the pelvis. Many, though not all, stones in the kidneys or bladder can be recognized. We may also distinguish by the rays between gout and rheumatism, and they are also useful to surgeons in cases of fracture, in dislocations, and diseases of bones, and in locating bullets and some other foreign bodies.

To make X-ray examinations, training is needed in two directions; the problems connected with the apparatus must be understood in order to get the best results, and a large medical experience must be at command in order to interpret what is seen on the fluorescent screen and correlate it with evidence obtained in other ways.

One word of warning in regard to X-ray examinations; it should be clearly understood that this new method is only one of many which may be used by medical men to determine from what disease a patient is suffering; but in many cases (especially in diseases

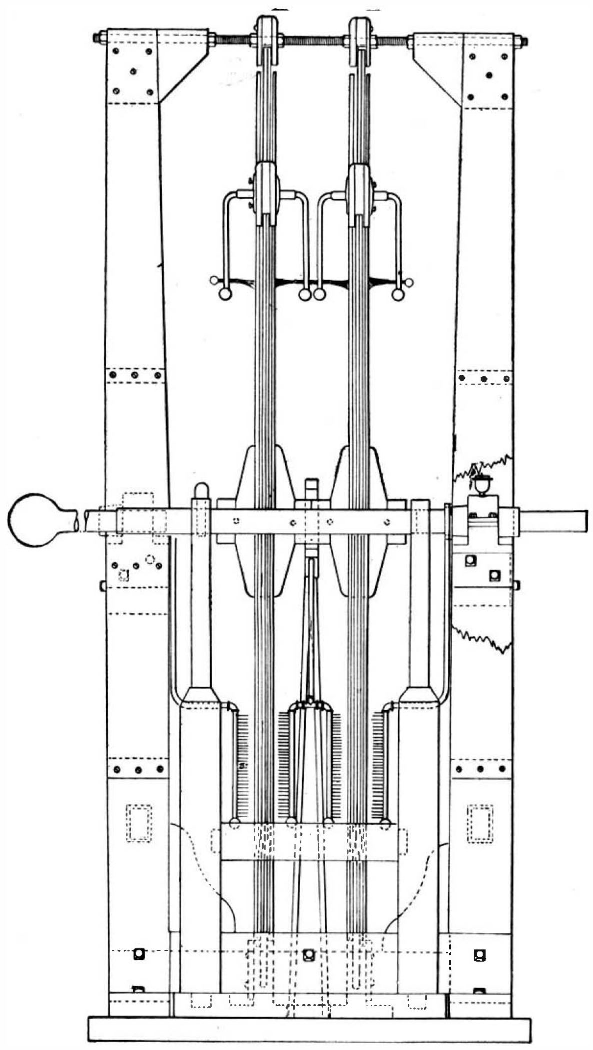


Fig. 3.—END ELEVATION.

of the chest) it is capable of giving valuable evidence, which by itself, or in connection with other signs and symptoms, serves to point out the disease.

The Uganda Railroad.

The British government has just completed 300 miles of the Uganda Railroad. The total length of the route from Mombasa on the Indian Ocean to the northeast coast of Victoria Nyanza is 650 miles; nearly half of the entire road, which is to connect the sea with Uganda, is practically completed. Uganda is one of the most populous and promising parts of Africa, stretching far along the northern and northwestern sides of the second largest fresh water lake in the world. The New York Sun recently gave some interesting particulars regarding this road, from which we glean the following: The railway has been pushed toward the lake, which is the objective point, for the past three years in spite of such serious obstacles as the abnormal rainfall of 1897, which retarded the preparation of the roadbed, and the breaking out of the plague in India. In the first 200 miles the conditions for railroad making were very unfavorable.

There are very few spots where water may be obtained. Last August, when the line was about 200 miles on its way, it had only just emerged from the difficult jungle country. On March 31 of this year the line reached 279 miles, touching the densely populated country southeast of Kenia. It is believed that the railroad will now have an appreciable effect on the export trade. Since August 20 of last year trains have run regularly over most of the route completed at that time; the stations on the way number thirteen. Two trains start every day, one from the coast and the other from the inland terminus; the trains stop for the night. Deducting all the time spent at way stations and in obtaining water, the actual traveling time for the 162 miles is ten and one-quarter hours. This is not very high speed, but is a great improvement over caravan traveling. Only mixed trains carrying freight as well as passengers are now running. The fares for the 162 miles are $20, $10, and $1.70. The latter is for third-class travel and is confined to native and Indian patronage.

Of the financial prospect of the line it is not easy to speak at present, but, unless there are some untoward circumstances, the government will reap much indirect profit from the road. It has been spending $200,000 a year merely for the transport of the material needed by its agents and stations in the lake region. It is estimated that the railroad will reduce this charge to $30,000 a year. The transportation of the steamboat which the government sent to Lake Victoria Nyanza cost $100,000, and it could have been sent by rail for one-fifth of this sum.

Prof. Lanier on the Combustion of Magnesium.

Herr A. Lanier, in the Correspondenz, calls attention to the advantage of reducing the smoke of the flash mixture to a minimum by using an oxidant which itself yields no smoke, nitrate of ammonia being mentioned. Owing, however, to the extremely hygroscopic nature of this substance, some care is required. The salt must be fused to expel moisture; as soon as sufficiently cooled it is finely powdered, and preserved in a well-closed bottle. Various sensitometric determinations were made, and it was found that a mixture of 2 parts of magnesium and 1 of ammonium nitrate gave the same illumination as a mixture of 1 part of magnesium and ¾ part of potassium permanganate. Equal parts of magnesium and ammonium nitrate showed 2·4 times the actinic power of a mixture in which 3 of magnesium and 1 of ammonium nitrate were used. From the point of view of reducing smoke, the use of ammonium nitrate is of very great value, as far less magnesium will serve than when the metal is burned without any addition. Five grains was found to be ample for a fully exposed carte portrait in an ordinary room, and after five exposures the smoke was scarcely noticeable. To ignite the mixture, Herr Lanier places it upon a tuft of pyroxyline or a pad of touch paper (soft paper soaked in a solution of niter and dried). A taper on the end of a light wand may then be used conveniently. He sums up the following as the essential matters in using the magnesium flash with a minimum of smoke: (1) complete dryness of the materials; (2) an extremely fine state of division; (3) complete mixture—each charge being mixed separately with a feather on a sheet of paper; (4) the use of a base of pyroxyline or touch paper.

Victorium.

At the conversazione of the British Royal Society on May 3, information was given by Sir William Crookes of the discovery of what he believed to be a new element. In his work on the fractionation of yttria, he found in a photograph of a spectrum not visible to the eye a group of lines indicating a new element. In honor of the eightieth birthday of the Queen he has proposed to call it victorium. Its atomic weight is probably near 117.

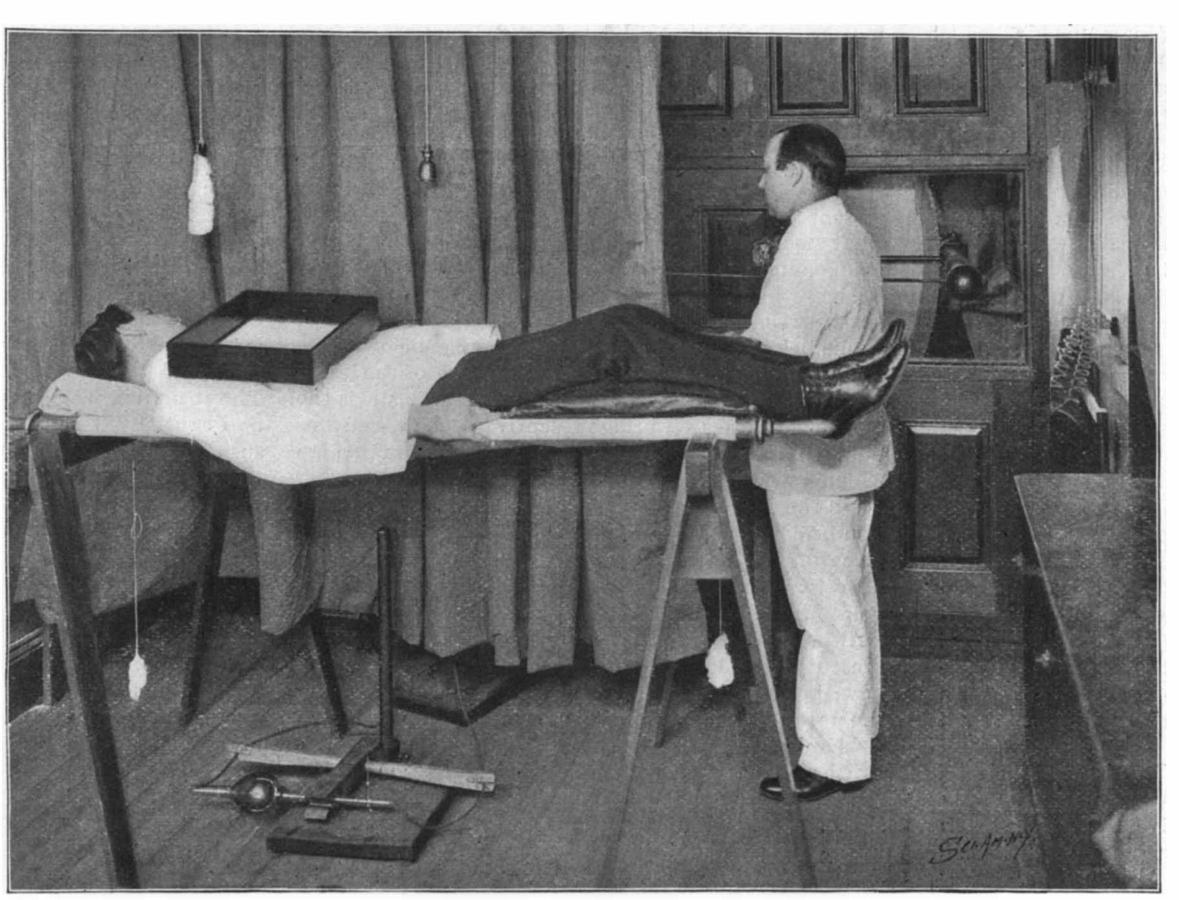


Fig. 4.—METHOD OF MAKING X-RAY EXAMINATION.

THE CUP CHALLENGER "SHAMROCK."

English yachtsmen, as represented in Sir Thomas Lipton, evidently do not believe greatly in the old adage which tells us that one should not "swap horses in crossing a stream," for at the very climax of their plucky attempts to regain the "America" cup, and just when their yachts are proving to be very dangerous competitors, we find them substituting a new designer in place of G. L. Watson, who turned out the "Valkyries," famous in the later history of the "America" cup races.

Among the better known British designers of yachts there are two who stand out pre-eminently in the production of successful racing machines. Expert opinion is divided as to the respective abilities of G. L. Watson and William Fife, Jr., the designer of the "Shamrock," although the former is better known to the general public on both sides of the Atlantic, because of the large number of racing yachts of the larger size, 80 to 90-footers, which he has produced. Fife has made his reputation chiefly in the smaller classes, some of his boats having proved to be all but unbeatable. His first attempt at a large craft was made in 1893, that banner year in international yacht racing, when he designed the "Calluna," an 80-foot cutter, for a syndicate of yachtsmen. She was not a success, and scored only one or two firsts in the whole of that season, being easily beaten by the American centerboard sloop "Navahoe." Fife's next attempt was the "Ailsa," a big 149-ton cutter, which made her debut in the Mediterranean in the spring of 1895, and created quite a sensation by beating the "Britannia," "Satanita," and other crack vessels by handsome margins. It had been agreed between the New York Yacht Club and Lord Dunraven, for whom the challenger, "Valkyrie III.," was at the time being built, that he should have the option of substituting any faster yacht, which might prove its superiority to his new boat, and bring her over to race for the cup, and it was for awhile confidently expected that the "Ailsa" would prove to be the boat selected. She did not, however, fulfill her first promise, and was

"VALKYRIE III." AND "SHAMROCK" COMPARED.

	"Valkyrie III."	"Shamrock."
Length over all	130 ft.	132 ft. 2 in.
Waterline length	88 ft. $10\frac{3}{16}$ in.	89 ft. 6 in.
Beam	26 ft. 2 in.	24 ft. 6 in.
Draught	20 ft.	20 ft.
Displacement	158 tons.	147 tons.
Sail area	13,026 sq. ft.	14,125 sq. ft.
Construction	Steel and wood.	Nickel steel, and manganese bronze.

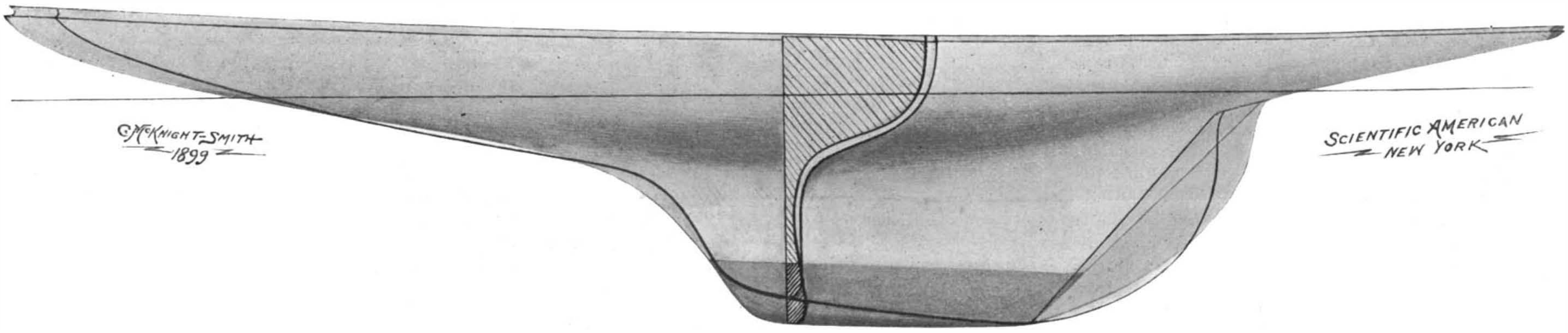
lightness of her hull, which weighs probably from seven to ten tons less than that of the "Valkyrie III." The weight saved in the hull can be put into the keel, where it adds immensely to the sail-carrying capacity. A reduction of nearly 2 feet in the beam, coupled with an addition of about a foot to the waterline length and 2 feet to the over-all length, means that "Shamrock" will have a form far more easy to drive than "Valkyrie III." With fairer lines, less displacement, less wetted surface, a lighter hull, and a considerably lower center of gravity (see sheer-plan), due to the absence of rise in the keel, and a larger sail-plan than "Valkyrie III.," the "Shamrock" should prove to be a very dangerous competitor—by far the most capable ever sent across the Atlantic. Whether she is as good a boat (having regard to the improved materials of construction) as Watson could have designed, remains to be proved; but there is no reason to suppose that Fife has failed to make as great an advance over "Ailsa" as "Ailsa," was over his first big boat, "Calluna."

THE BRIDGES OF NIAGARA GORGE.

By no means the least interesting feature of Niagara Falls and that stretch of the river whose scenic features have assisted to make this locality world-famous, is the number of picturesque bridges which span the gorge, and form important links between the American and Canadian shores. In our issue of May 27, we gave a lengthy description of the natural features of Niagara Falls and River, accompanied by engravings showing

carriages could not pass each other upon it, long delays were frequent at either end. In 1887 the bridge was enlarged to a width of 17 feet, new 2½-inch steel cables and additional anchorages being added. The work was finished December 15, 1888, and on the night of January 9-10, 1889, the bridge, scarce a month old, was swept away by a fierce southwesterly hurricane. The rebuilding of the structure was at once commenced, and on May 7, four months after the disaster, it was again open to traffic.

The development of the electric railways on each side of the gorge and the evident advantages of making a connection at each end, and so forming a continuous belt line, led to the erection of the present magnificent arch bridge opened in 1898, whose span of 840 feet far exceeds that of any other arch bridge in the world, the next longest being the center span of the highway bridge at Bonn, Germany, which measures 639½ feet in length. The total length of the bridge is 1,240 feet and the rise 150 feet, the main span being supplemented by two shore spans, one 190 feet and the other 210 feet in length, which serve to carry the superstructure to a connection with the top of the cliffs. The masonry abutments of the main span are built at the edge of the river banks, the distance laterally between centers being 68 feet 9 inches. The two trusses have an inward batter at the rate of $1\frac{7}{8}$ in 12, and the posts of the supporting bents which carry the roadway lie in the same plane. The bents rest upon the alternate panel points of the trusses and they are strongly braced against longitudinal and lateral distortion. The roadway, 49 feet in width, provides two electric tracks, two driveways, and two footwalks for passengers. The shore spans are inverted bowstring trusses of graceful proportions. It is scarcely possible to speak in too high praise of the beauty and general engineering merit of this structure, and great credit is due to Mr. L. L. Buck and his assistants for having treated this formidable problem with such excellent æsthetic results that it rather adds than detracts from the scenic effects at this part of the gorge. In our illustrations of



THE CUP CHALLENGER "SHAMROCK."

Shaded hull and lined section show "Shamrock"; heavy outline shows "Valkyrie III."

completely worsted by the three-year-old "Britannia," during the 1895 season, with the result that she was regarded as being only something less of a failure than the "Calluna." At the close of the season, Fife took the yacht in hand again and made changes to such good effect that in subsequent seasons she easily disposed of the other big yachts of her date and scored a brilliant series of victories. Another famous Fife boat in the larger classes was the 65-footer "Isolde," which, under the captaincy of Hogarth, who has been selected as the captain of the "Shamrock," achieved one of the most brilliant reputations ever made by an English yacht, winning in four successive seasons 180 firsts, 95 seconds, and about $20,000 worth of prizes.

We have deferred publishing any data regarding the "Shamrock" until we were in a position to secure it from a reliable source, and we are now enabled to present a sheer plan and midship section of the challenger, with her leading dimensions. If the drawings are compared with those of the "Columbia," which appeared in the SCIENTIFIC AMERICAN of March 18, 1899, it will be seen that there is a striking general resemblance between the two yachts. The waterline length, 89 feet 6 inches, is the same, both boats being built up to the allowable limit of 90 feet, with half a foot allowance for change of trim and possible variation of the actual from the calculated displacement. Both boats have the same draught of 20 feet. The "Shamrock" has a few inches more beam and is about a foot longer over all. In sail area the "Shamrock" will have a slight advantage, although this is necessarily a variable quantity in both boats, and may be enlarged or reduced (probably the former) when they are in the course of "tuning up." A considerable addition was made to "Defender's" sail area after her first few trials under canvas.

A comparison of "Shamrock" with "Valkyrie III." shows that she should be a faster boat. Not only is her model finer and easier to drive through the water, but she is considerably lighter as the result of the materials used in her construction. Although her displacement is several tons less than that of "Valkyrie III.," her sail-spread is greater. This results chiefly from the

the peculiar topographical character of the country. A brief glance at these engravings is sufficient to reveal the causes which have led to the bridges being thrown across the river below and not above the falls. Above the falls the river though shallow is extremely broad, widening in places to from 2 to 3 miles, and a crossing would be necessarily very costly. Below the falls, however, although the river is either too deep or too swift to admit of piers or even temporary false work, it is comparatively narrow, the distance from bank to bank at the summit varying from 1,200 feet just below the falls to 700 or 800 feet at the railroad bridges a mile further down the river. By reference to the engraving in the article referred to showing a bird's eye view of Niagara, it will be seen that there are at present four bridges across the gorge. The first is the great steel arch structure, known locally as the Upper Bridge, and again as the Niagara Falls and Clifton Bridge, which spans the river with a single arch, 840 feet between abutments, at a point about a quarter of a mile below the American Falls. A mile below is the cantilever bridge which carries the tracks of the Michigan Central Railroad, while closely adjoining it is the handsome steel arch bridge recently opened which was built to replace the old railroad suspension bridge which stood on the same side. A few miles further down the gorge, at Lewiston and Queenston, a suspension bridge is nearing completion which will take the place of the wrecked structure, the cables of which have for many years been a familiar feature at this point on the river.

Although it is true that there are but four bridges at present in existence, no less than nine separate bridges have been built at Niagara at different times during the past fifty years, the earlier structures having been either destroyed by windstorms or rendered obsolete by the advance of engineering and the growing demands of traffic. The first bridge to be erected at the site of the new Niagara Falls and Clifton structure was a suspension bridge of wood and iron, opened January 2, 1869, whose span was over 1,200 feet. The cables were of iron wire, the towers and the roadway of wood. It was only 10 feet in width, and, as two

the bridge the point of view is on the Canadian shore looking northeast toward the Hydraulic Power Company's plant, just beyond which is seen the cascades formed by the tailraces of various smaller factories. The outlet of the 7,000-foot tunnel which discharges the water from the Niagara Power Company's plant is seen just below the downstream abutment of the arch bridge.

It is not necessary to give any lengthy description of the cantilever railroad bridge, a mile below the arch—so well is it known to the public. It was built in 1883 from the designs of Mr. C. C. Schneider and opened in December of that year. The crossing is about 100 yards above the site of the new steel arch, and the gorge at this point is 850 feet in width at the crest and 425 feet at the river edge, the depth to the surface of the water being 210 feet. As it was impossible to use false work, Mr. Schneider designed a cantilever bridge, with towers located at the foot of the sloping cliffs, and built out the main span by overhang—a method he had already carried through successfully at the Fraser River on the line of the Canadian Pacific Railway. The structure, which carries a double track, consists of two cantilevers resting on the towers and a central suspended truss. The shore arms of the cantilevers are 195 feet 2 inches and the river arms 175 feet in length, while the supported span is 119 feet 10 inches long, the total clear span between the towers being 470 feet, and the total length of the bridge between the anchorages on the edge of each cliff is a few inches over 910 feet. Although later developments in cantilever construction have rendered the Niagara bridge insignificant in comparison, the spans of the Forth bridge, for instance, being 1,710 feet, the Niagara cantilever will always be notable as being one of the earliest successful applications of the cantilever system of construction. The structure carries a double track, and it was designed for a rolling load consisting of two 66-ton locomotives followed by a trainload of 2,000 pounds to the lineal foot.

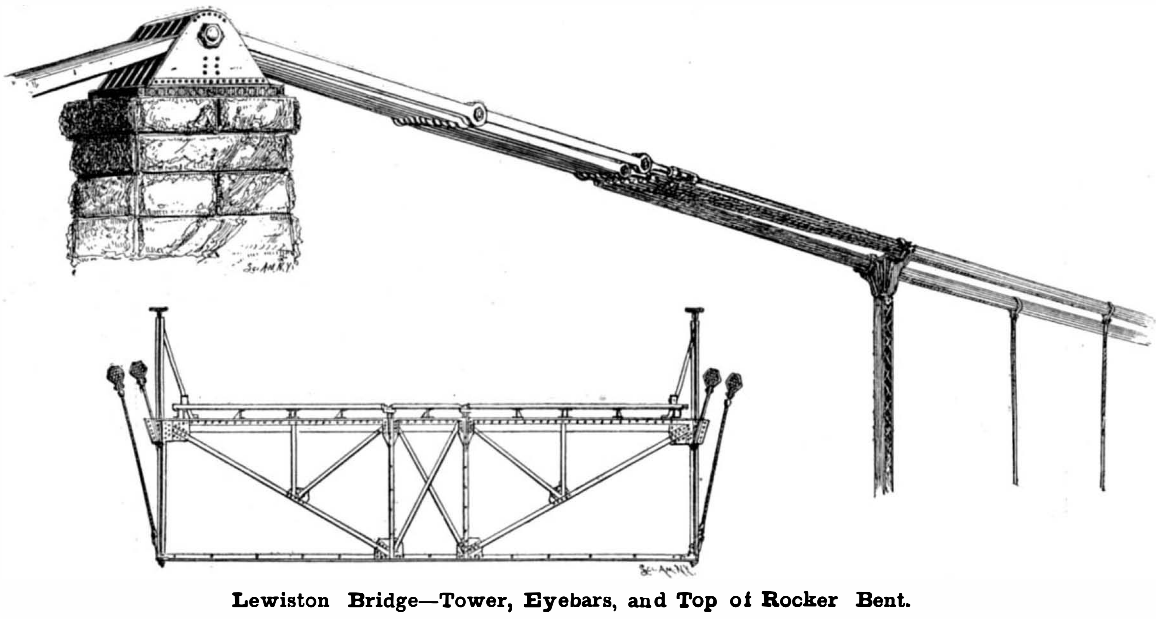
This was ample in 1883, but now, after a lapse of sixteen years, we have locomotives on some American roads weighing, with tender, up to 167 tons, and trains that

will average 4,000 pounds rolling load to the foot. To meet the changed conditions the Michigan Central Railroad is now strengthening the whole structure in an ingenious and novel manner. A new truss equal in strength to the other two is to be built through the center of the structure from shore to shore, new bents and masonry foundations being erected in the center of the towers. The reconstructed bridge is to have an increased carrying power of 50 per cent.

The adjoining bridge site, 300 feet down stream, is of special interest, exceeding indeed any other across the gorge. Here, in 1848, was erected the first bridge to span the then formidable chasm. It was a crude affair, though creditable to its designer, Mr. Charles Ellet, if we consider the early date and the lack of appliances. The floor was only 7½ feet in width and it was not provided with any stiffening truss. In 1853 it gave place to the famous railway suspension bridge designed by Mr. John A. Roebling, in which the theories of the strength of materials and the strains in framed and suspended structures received a more thorough application than had ever before been attempted in this country. It required all the courage of Mr. Roebling's convictions to erect a suspension bridge for carrying railroad trains at a time when opinion inclined to the more rigid systems for this class of bridge; but the structure, although it has now been replaced by a steel arch, proved to be fully adequate to its duties for several decades of very severe work. The span measured 821 feet 4 inches between towers. It was carried on four cables of iron wire, 10 inches in diameter, and the floor system was double-decked, the upper deck carrying a single railroad track and the lower being used for common travel. It was stiffened by two timber trusses, 18 feet in depth, the trusses being built on the Pratt system.

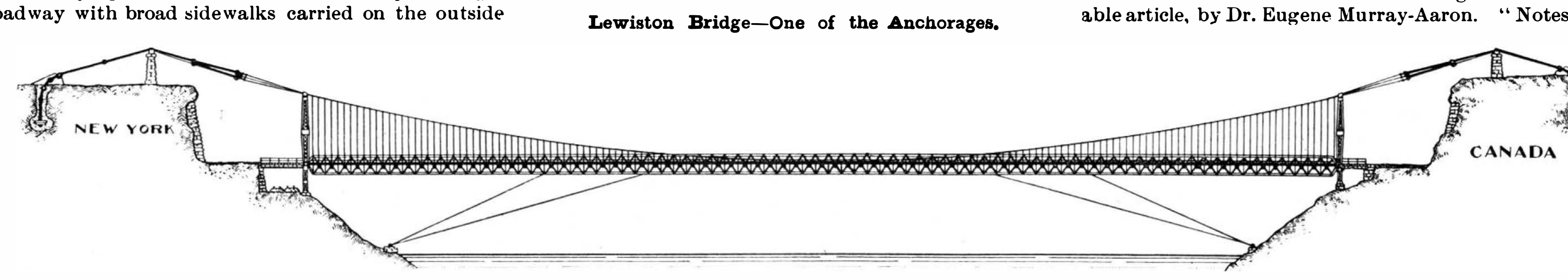
It should be mentioned that the wires of the early Ellet bridge were incorporated in the Roebling structure, and when the latter was taken down after forty-two years of service, the original strands curled up, taking the set they had carried when in the reel. In 1877 it was found that corrosion of the wires had taken place, and the defective material was taken out and other wires inserted and spliced, and at the same time the wooden truss was replaced by one of iron. In 1886 the stone towers showed such signs of deterioration that it was decided to replace them later with new towers of steel. This difficult task was accomplished by Mr. L. L. Buck, who also was responsible for the repairs of 1877, without any interference with the traffic. The Niagara Railway Arch, as it is called, is a two-hinged, spandrel-braced arch of 550 feet span and 114 feet rise. The masonry abutments are built about half way down the slope of the gorge, upon a solid stratum of gray limestone, and the main arch is flanked by two connecting shore spans, 115 feet in length, which carry the floor system from the arch to the edge of the adjoining cliffs. The structure is double-decked, the upper deck carrying two tracks and the lower providing a roadway with broad sidewalks carried on the outside of the trusses. The bridge is proportioned for a live load on each of the tracks of two 128-ton engines, followed by a train load of 3,500 pounds to the foot, besides the live load due to travel on the road and foot ways on the lower deck. The bridge was erected by building the shore trusses upon false work, tying them back to anchorages on the shore and then building out the main arch by overhang, as shown in our first page engraving. The material was brought out upon the suspension bridge and handled by travelers which ran upon the top chords of the arch trusses. The new bridge was built and the old bridge removed without any interruption of the traffic—a result which is greatly to the credit of Mr. Buck and his assistant, Mr. Richard S. Buck, the resident engineer in charge of construction at the site.

The Lewiston suspension bridge, which is now nearing completion, will also stand upon the site of an earlier structure—the old Lewiston suspension bridge, which was built in 1851–52 and destroyed by a windstorm on the morning of February 1, 1864. The new bridge will connect the southern termini of the Gorge Railroad (electric) which follows the cliff and shore line of the river from Niagara to Lewiston, on the American side, and the Niagara Falls Park and River Electric Railway, which runs near the edge of the cliff from above the Falls to Queenston on the Canadian side. The new bridge with the upper arch bridge will thus enable the tourist to make a complete circuit of the most interesting portion of the gorge without a change of car. The general appearance of the bridge can be judged from the accompanying drawing, and the principal dimensions are as follows: Distance from tower to tower, 1,040 feet; span of stiffening truss, 800 feet; width, 28 feet; width of roadway, 25 feet. The bridge carries a single electric track with a roadway on each side of it; but no special provision is made for the limited foot passenger traffic. The connecting span on the New York side will be 34½ feet long and that on the Canadian side 19½ feet. Much of the masonry of the towers came out of the towers of the old bridge. There are four cables, each consisting of fourteen 2½-inch steel wire ropes, the ropes being those which formerly carried the upper suspension bridge, already described. They were long enough to allow of their being cut in half and used in the new bridge, and to piece out the necessary span between towers, 75 feet at the end of each cable will be made up of eye-bars. The cables are continued in the eye-bar form from the towers down to the anchorages, 150 feet back from the edge of the cliffs. Here the eye-bars are carried into a shaft, at the bottom of which they are connected to anchor plates, the hole being filled up with concrete. A view of the top of an anchorage is shown in the accompanying cut. At each of the points where the suspended structure connects with the short flanking spans a rocker bent is introduced which rests on a shoe below and extends up to the cables above. The bent is hinged at the shoe, at the end of the truss, and at the cable. This construction, and indeed the whole bridge, is novel and not by any means lacking in picturesque effect.



Lewiston Bridge—Tower, Eyebars, and Top of Rocker Bent.

Lewiston Bridge—One of the Anchorages.



Lewiston Suspension Bridge, Niagara River—Span Between Towers, 1,040 Feet; Length of Stiffening Truss, 800 Feet.

THE BRIDGES OF NIAGARA GORGE.

Workingmen's Houses in Germany.

Vice-Consul J. F. Monaghan writes from Chemnitz, saying that there is a movement on foot to furnish workingmen with better tenements. Now, they are crowded into buildings which often look like barracks. The proposed houses will be built upon lots about 16½ feet wide by 102 feet deep, thereby allowing for a front yard for flowers and a back yard for a vegetable garden and shed, the latter for the keeping of poultry or some domestic animal. The houses will contain five rooms. A parlor and kitchen will be on the first floor, the parlor containing a porcelain stove and heating pipes, and the kitchen a wash boiler and stove. The three bedrooms on the second floor will easily hold five or six persons, and can be made to accommodate ten. In the largest an iron stove will be placed. A pump will provide water where the city waterworks do not extend to the house. In connection with the shed is a water-closet. The cost of such a house and lot, when a number are built at a time, will be between $850 and $940. It will rent for about $53 a year—that is, for the same price the workingman has to pay for two rooms in the barrack-like tenements of the large cities.

The Death of Isaac G. Johnson.

Isaac G. Johnson died at his Spuyten Duyvil home on June 3, in the sixty-eighth year of his age. He was born in Troy and graduated in 1848 at Rensselaer Polytechnic Institute. He soon entered upon the manufacture of malleable iron in Spuyten Duyvil, and in later years turned his attention to steel manufacture. He was well known as an inventor, and he secured a patent on a cap for armor-piercing shell. This was purchased by the Navy Department, and proved of the greatest value at the time of the destruction of Admiral Cervera's fleet.

The Current Supplement.

The current SUPPLEMENT, No. 1224, has many articles of great interest. "The School of Anthropometry at the Prefecture of Police" is an article fully illustrated. "Into the Heart of China" is the narrative of a journey through the center of China taken by Mr. W. Kirkpatrick Brice and is most interesting. "The Elephant and Its Ancestors" is an important article by W. Von Reichenau, and is freely illustrated. "The 'Wourali' Poison and Its Uses" is an original and valuable article, by Dr. Eugene Murray-Aaron. "Notes on the Abyssinians" is fully illustrated. "The Commercial Development of Germany" is continued, and an article on "Graphite, Its Formation and Manufacture," by Prof. Acheson, completes this very interesting number.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Bicycle-Appliances.

PEDAL.—CHARLES D. WALKER, Honolulu, Hawaii. The pedal comprises a disk held upon the crank and carrying on its periphery a pedal-ring having rotation upon balls running in raceways on the periphery of the disk. The pedal-ring carries a foot-support. As the pedal moves down, the rider's foot inclines the foot-support so that its rear end is lower than the front end, the greater portion of the support being in the rear of the pin. By reason of this arrangement, it is claimed that the rider secures a foothold which will reduce the strain on the pedal ball-bearings, and which will facilitate ankle-motion.

DRIVING-GEAR.—EDWIN C. POHLÉ, Denver, Colo. On the bicycles in general use, the pedal is made to describe a complete circle, thus causing the foot to pass through a similar path, while the effectual advance of the foot is equal only to the diameter of the circle. In the present invention, the pedals advance through sixty degrees and then return, thereby avoiding much of the usual unnecessary motion. The inventor gives a reciprocating motion to the pedals by the introduction of a connection between the crank-shafts, and by a piston-rod connection with the driving-wheel, so that the power applied to one pedal advancing, causes the other to return; or the momentum of the bicycle carries the pedals through this advancing and returning motion. The rider can, therefore, use his power either in driving or retarding the bicycle.

ADJUSTABLE HANDLE-BAR. — JESSE ALEXANDER, Brooklyn, New York city. The hollow cross-head of the bar is slotted in alinement with the steering-post. A spring-pressed slide-bar is adapted to engage a perforation in the handle-bar within the hollow cross-head. A bolt passes across the post through perforations therein, to clamp it and the hollow cross head. By depressing the slide bar, the handles can be raised or lowered to any position. The slide bar, upon being released, springs into engagement with the slotted cross-head and holds the bar in position.

Electrical Apparatus.

ELECTRIC LIGHTING APPARATUS.—ANDREW PLECHER, Savannah, Ga. This apparatus is designed to be employed for especial X-ray illumination, or for general electric lighting. The lamp used comprises a vacuum-bulb in which is located one pole of an electro-magnet having a fluorescent surface. The helix of the magnet is arranged in a primary circuit-wire around which an insulated secondary wire is wound throughout its length between lamps. The helix extends the full length of the primary wire between lamps, and is provided in the bulb with cathode-terminals. The cathode rays, as they radiate from the terminals, are laterally deflected by the influence of the magnet, and in bombarding the especially-prepared surface, cause that fluorescent surface to shine intensely.

Mechanical Devices.

GRAVITY-MACHINE. — WILLIAM H. HAWKES, Ann Arbor, Mich. This machine is designed to measure the distances a body falls during successive equal intervals of time, in order to show experimentally the acceleration due to gravity, at the same time to record the measured distances. Upon the frame of the machine a pulley is journaled, about which passes a band carrying a weight. Over the band a pencil is mounted, which is actuated by the armature-lever of an electromagnet to leave a mark upon the moving band. In the circuit of the magnet a mercury-cup is placed, into which dips the lower end of a pendulum. The pendulum in swinging dips into the mercury at the end of each down stroke, completes the circuit, and causes the pencil to leave a mark upon the band. These marks represent the distances fallen by the body carried by the band during the beats of the pendulum.

Miscellaneous Inventions.

BARREL-COVER-TIE HOLDER. — COLONEL F. DEAN, Carmel, N. Y. The holder provided by this inventor is designed to hold a cloth cover on the barrel. The holder consists of a single length of wire bent to form two concentric rings and having the ends turned around the rings at top and bottom and then turned outwardly to form prongs to be driven into the barrel. The device is to be permanently attached to a barrel, and is designed to be used many times for shipment and reshipment.

FUMIGATING SHOE-TREE. — JOHN S. BUSKY, Brooklyn, New York city. The tree is hollowed to form a cavity in which an antiseptic or fumigating apparatus is placed, provided with means for impregnating it with an antiseptic liquid. The tree has openings from the interior cavity to the outside, through which the liquid may act upon the shoe.

GARMENT-HANGER.—ADAM K. BOWMAN, Greensburg, Pa. This hanger for skirts and the like consists of skeleton wings extended in opposite directions. Each wing has an upward and outward inclination and is provided with an inclined end supporting-section. A coil connects the lower members of the wings, and a shank extends upwardly from the junction of the two wings. If the waistband should become unbuttoned, the skirt could not drop from the device, since the weight of the skirt would carry the wings down until they had spread apart sufficiently to hold the skirt.

HINGED BUCKLE. — JESSE R. YOUNG, 710 Bank Street, Kansas City, Mo. Considerable difficulty is experienced in sewing a buckle to a strap or rein because the rigid metal keeper is in the way of the needle and presser-foot of the sewing-machine, so that several stitches have to be sewn by hand. To overcome this difficulty, the inventor hinges his keeper to the buckle, folding it over so that the sewing can proceed without interference. After the stitching is completed, the keeper is folded back over the strap, and riveted in place.

VEST.—JOSEPH G. EWING, McDonald, Pa. In order to economize material and labor, and thus reduce the cost of manufacturing coats and vests, means have been devised for providing false lapels which resemble those of the usual construction. The means consist in turning the cloth over at the front edge of the vest and holding it in place by a piece of inelastic tape stitched to the cloth. This line of stitching and the lapped edge of the cloth form a pocket which is stuffed to form a swell resembling the lapel ordinarily seen on a coat or vest.

FILTERING APPARATUS.—CHARLES V. F. LUDWIG, St. Louis, Mo. The purpose of the present invention is to provide a filtering apparatus designed to purify the water of rivers and streams, the apparatus being arranged to filter the water directly and to return the sediment to the source of supply. The filter has a filtering-wall of porous stone constructed with arches. Revoluble brushes are in contact with the arch-surfaces and have propellers which are actuated by the current. The propellers turn the brushes so that any sediment passing under the arches is scraped off. The sediment thus removed readily floats off or settles.

ACETYLENE-GAS GENERATOR. — OLIVER H. HAMPTON, Williamsburg, Ind. The bell of the gasometer has a sliding connection with a weight normally resting on a support in the tank and is connected with the generator by a vertical gas-pipe. A bell in the generator-tank is provided with a depending tube sliding on the gas-pipe, and is apertured at its upper end to permit the escape of the gas. The acetylene generated flows into the gasometer-bell, and when the pressure of the gas has risen within this bell to the desired degree, the gasometer-bell overbalances the generator-bell, and the latter is forced upwardly by the pressure of the gas.

ATTACHMENT FOR TYPE-FORMING MACHINES.—CHARLES A. HOLLENBECK and RICHARD F. WILSON, Albany, N. Y. The generally-employed method of forming linotype or line slugs, consists in casting a line of one table on one slug and a line of the other on the other slug; and, after cutting off the blank parts of the slugs, the portions containing the tables are placed end to end. In order to overcome the difficulties of this tedious process, the present invention provides an assembling-slide carrying an adjustable upright and a fixed upright. By means of the improvement the inventors are enabled to cast on one slug a portion of each table, and at the same time maintain an alinement of the tables.

PUZZLE.—HERMAN SCHLIRF, Ashland, Wis. This puzzle or game consists of a board in which are sunk stalls in the shape of the numerals "1900." These stalls communicate with a circular pathway around a disk, which circular pathway communicates with other pathways. In the pathways large and small balls are adapted to travel, the board being so tilted that one large and one small ball shall roll into each of the stalls constituting the numeral "1900." Owing to the peculiar form of the stalls, the inventor has termed his game "The Nineteenth Century Puzzle."

SEAT FOR MARKET-WAGONS. — GEORGE A. KINSEY, Springland, Queens, New York city. A simple, revolving, canopy-top seat has been devised by this inventor, which is especially adapted for use upon market-wagons and which is capable of facing the front or rear, so that when the wagon is at the stand the farmer may face his load and at the same time occupy the seat of the wagon and enjoy the protection of its attached canopy. The seat is pivoted at the transverse center of the body so that it can be readily swung.

PRODUCT FROM BLAST-FURNACE SLAG. — ALEXANDER D. ELBERS, Hoboken, N. J. Pulverized blast-furnace slag cannot be desulfurized in a practical manner by roasting it without suitable admixture, or in its crude state, because it is apt to rescorify before the sulfur is fully removed. The roastings are liable to become too dense for the proper admission of air before even the first half of the sulfur has been expelled, and will hence certainly rescorify during the progress of the heating. In order to obviate these and other difficulties, the inventor combines his pulverized desulfurized slag with three-fourths of one per cent and upward of sodium or potassium oxid in the fritted state. The products of this treatment are useful as a flux for the manufacture of glass and pottery, and as an admixture to hydraulic cements.

MEANS FOR DETACHING HARNESS FROM SHAFTS.—FREDERICK DICKERBOOM, Mankato, Minn. The attachment comprises a casing having an under-cut groove in which a slide having a notch moves. A lock-bar is fitted in the casing and has a shoulder adapted to engage in the notch of the slide, the lock-bar moving bodily toward and from the slide. A bow-spring bears with its ends on the lock-bar and with its intermediate portion on the casing to push the lock-bar toward the slide. An eccentric-pin is mounted in the casing and engages the lock-bar at the side opposite to the spring by which to move the lock-bar against the spring and away from the slide. The attachment is to be applied to the thills and to be connected with the harness.

ATOMIZER. — WILLIAM E. WHITTIER, Brooklyn, New York city. An improved atomizer has been provided by this inventor, which is arranged to atomize a liquid and vaporize another in a very simple manner. The device comprises an inner and an outer receptacle. Air-inlet pipes lead to the inner and outer receptacles and are adapted for connection with an air-supply. Separate outlets extend from the inner and outer receptacles, each of the outlets terminating in a separate discharge-nozzle exteriorly of the receptacles, whereby the medicaments contained in the receptacles may be successively applied.

ADVERTISING MEDIUM.—JOHN A. ANIELLO, New Orleans, La. The medium consists of a wheeled vehicle in the body of which a shaft is arranged to be driven by the movement of the vehicle. Another shaft is provided which, when turned, operates a musical instrument. The various shafts have pulleys and belts to transmit power from one to the other. When the vehicle moves, motion is given to endless advertising bands carried by the vehicle; music is produced to attract attention; and in addition a figure is made to appear periodically to attract still further attention.

CHEMICAL FIRE-EXTINGUISHER.— ABRAM H. VAN RIPER and PATRICK F. GUTHRIE, Nutley, N. J. The apparatus comprises a main cylinder connected with a gas-pressure cylinder, an auxiliary cylinder connected by a pipe with the main cylinder, a plunger operating in the auxiliary cylinder, and a hopper containing a chemical cartridge and having a connection with the auxiliary cylinder. The main cylinder, filled with a chemical solution, is charged with gas from the gas-cylinder, the pressure causing the solution to be discharged through a hose. Water is poured into the hopper, and this water, passing through the chemical cartridge will form a solution which can be forced into the main cylinder by means of the plunger.

REVOLVING BLACKBOARD.—MARTIN W. TUBBS, Portville, N. Y. The revolving blackboard is arranged to carry a number of flexible blackboards normally wound on rollers, but adapted to be singly unwound and extended over and fastened to a fixed support, and used like an ordinary blackboard. The whole arrangement requires wall space for but a single blackboard, with the advantage of having the use of several, and of concealing or exposing work at the pleasure of the teacher.

INCANDESCENT-ELECTRIC-LAMP FIXTURE.—BENJAMIN F. ROUT, Stanford, Ky. The lamp-fixture comprises a support on which a casing-section is rigidly mounted. Another casing-section is mounted to rotate relatively to the fixed section. A drum is secured to the rotatable section and is designed to receive and wind the electric conductors. A spring moves the drum and rotatable section; and a socket on the rotatable section receives the incandescent bulb. The lamp may be used both as a hanging lamp or as a standing lamp. In the former case the lamp, when drawn down, causes the rotating drum to unwind the conductors and to wind up the spring. The lamp upon being released from its position, is drawn up by the spring.

GATE-LATCH.—OLIVER E. POTTER, Cameron, Miss. This invention provides a gate composed of two parts pivoted to swing toward and from each other. Upon one-half of the gate a double latch is mounted, composed of toothed plates pivoted one upon each side of the gate, the outer or free ends thereof flaring outwardly to form a guide in order properly to register the two halves of the gate. Locking projections upon each side of the other half of the gate are engageable by the toothed plates.

BRACKET-SUPPORT FOR WINDOW-SHADES.—DAVID D. O'CONNELL, Wallace, Idaho. The bracket-support comprises bars held to slide upon each other, each bar being provided with a series of keyhole-slots. Buttons on the inner end portions of the bars are adapted to enter and to slide in the keyhole-slots. Each bar also has vertical openings near its outer ends. Angular hangers are provided, one member of the hangers being adapted to enter the openings. Clamping devices are located on the outer ends of the bars. The bracket-support is readily adjustable to any width of window and can be secured so as not to injure the window-casing.

HINGE. — HYMAN G. HILZHEIM, Jackson, Miss. This hinge consists of four leaves or sections, and three pivotal joints or points of articulation, the outer leaves being somewhat narrower than the inner leaves, and having screw-holes and free outer edges for connection with the door and the jamb respectively. The hinge, when the door is closed, is entirely concealed. Hence for safes, whose hinges should be carefully protected, for piano-tops, or for other smooth surfaces, the hinge is of especial service.

HORSE-POWER AND PUMPING-JACK.—BENJAMIN F. DARLINGTON and EDWIN P. CLARY, San Antonio, Tex. The present invention provides, in connection with a rotating head or turn-table, a sweep or shaft which rotates with the turn-table or head, being journaled therein, and which has a crank connected with the pumping-devices and a wheel rolling on the ground, or other suitable bearing, and operating to turn the shaft or sweep as the turn-table or head is rotated.

OIL-WELL PACKER.—JOSEPH DARLING, Chicora, Penn. The improvement devised by the inventor provides, in connection with the usual packer and the slips co-operating therewith, detent devices for restraining the slips, which may be set and reset. In connection with the slips a spring is furnished, secured at one end to the slips. A holder at the other end of the spring binds within the well-hole. The detent devices may be automatically readjusted to secure the resetting of the packer at either a higher or a lower level.

AUTOMATIC LUBRICATOR FOR LOOSE PULLEYS.—KARL WIDMANN, Pattendorf, Austria-Hungary. The lubricator is designed to be used on loose pulleys, and is especially adapted to those pulleys which are driven at very high speeds. On the shaft a sleeve is mounted, which carries a dripping cup. The pulley has a hub formed in two hollow sections. Each section has a ring loosely mounted on the sleeve, which ring forms an oil chamber through which the dripping-cup moves. The oil is thus constantly brought into contact with the revolving parts.

OIL-GAS LAMP.—JAMES A. YARTON, Omaha, Neb. This invention comprises an improved form of generator and shield therefor, together with a method of supporting the lamp so that it may be swung to one side, and thus drawn from under the generator. The invention also comprises an improved construction of controlling-valve and settling-chambers, whereby any sediment in the oil is prevented from entering the generator-tube. A further novel feature is found in the direct contact of the filling wires in the generating-tube with the tip, whereby the tip is more thoroughly heated and condensation of the vapors and consequent clogging of the tip prevented.

Designs.

SHOULDER-GARMENT.—FRANK F. AMSDEN, Malone, N. Y. One of the features of this design consists in forming the shoulder-garment with straight lower edges at back and front, and with curved lines at the sides.

PENCIL-HOLDER.—MALCOLM WILLIAMS, Pasadena, Cal. The pencil-holder is a tube having a studded exterior surface, the studs serving to prevent the pencil's falling from the pocket.

CHURN-FRAME. — MATTIE O. MORROW, Sulphur Springs, Tex. The churn-frame supports the heater and aerating devices entirely from the upper end, so that the latter are maintained in a suspended position in order that any kind of churn-receptacle may be placed on the frame and used in churning the butter. This saves the farmer the expense of buying an entire churn. The frame is built of wood and may be constructed by any carpenter, or farmer familiar with the use of woodworking tools.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated: correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(7674) G. S. W. writes: I have looked in many books of reference here and have been unable to find a receipt for kalsomining. Will you kindly answer in your inquiry column. A. Prepared kalsomine can be readily purchased at any large paint store, but some of our readers may wish to prepare their own kalsomine. The following rules are given for the purpose of enabling them to do so: Soak 1 pound of white glue over night, then dissolve it in boiling water and add 20 pounds of Paris white, diluting with water until the mixture is of the consistency of rich milk. To this any tint can be given that is desired. Lilac.—Add to the kalsomine 2 parts of Prussian blue and 1 part of vermilion, stirring the mixture thoroughly and taking care to avoid too high a color. Brown.—Burnt umber. Gray.—Raw umber, with a trifling amount of lampblack. Rose.—Three parts of vermilion and 1 part of red lead, added in very small quantities until a delicate shade is produced. Lavender.—Make a light blue and tint it slightly with vermilion. Straw.—Chrome yellow with a touch of Spanish brown. Buff.—Two parts of spruce, or Indian yellow, and one part of burnt sienna. Blue.—A small quantity of Prussian blue will give a soft azure tint. Dark blue is never desirable. Delicate tints in the foregoing varieties of colors are always agreeable and tasteful, and so great care must be taken that they are not too vivid. The tints will always appear brighter than in the kalsomine pot, and this fact must be kept in mind when adding the coloring powders.

(7675) A. R. W. writes: Please send prices of the first books necessary to be studied in taking an electric engineer's course. A. We should advise you to begin with Thompson's "Elementary Lessons in Electricity," price $1.40; Crocker's "Electric Lighting," price $3; Hawkins & Wallis' "Dynamo," price $3; all by mail.

(7676) Subscriber asks: If a stream of water is played on a trolley wire from a 1½-inch nozzle what effect will it have on the man holding the pipe, if any, standing on dry or wet ground? A. We should not expect any effect either agreeable or disagreeable.

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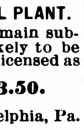

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Clasp member, Lewis & Mixer 30,948, 30,949
Clip, paper, G. P. Farmer 30,946
Clock dial, M. M. Gillam 30,937
Communion cup filler, E. W. Ryan 30,935
Counter wall fixture, W. C. Huss 30,960
Cream separator bottom, C. F. Hawkins 30,962
Envelop blank, R. A. Byrne 30,943
Exercising machine terminal member, E. R. Goodridge 30,972
Eyeglass case, H. E. Guyer 30,934
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Hinge, W. Taylor 30,954
Hinge guard arm, J. H. Pineo 30,953
Hook for waistband fastenings, W. I. Everson 30,950
Horseshoe, D. Howe 30,966
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Lamp body, P. C. Avery 30,941
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Nut lock washer, Chapman & Gelatt 30,955
Rail, J. P. Johnson 30,958
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Scale, F. Taylor 30,938, 30,939
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Stove, heating, E. H. Huenefeld 30,963
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Vehicle motor casing, H. S. Baldwin 30,968
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Window light, C. N. Schmitt 30,964

TRADE MARKS.

Accordions, Lyon & Healy 33,013
Ammunition, certain named, Peters Cartridge Company 33,053
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Baking powder, J. P. Dieter Company 33,038
Bearings for vehicle wheels, roller, J. R. Richardson 33,054
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Bronces, brocades, and bronce colors, Eiermann & Tabor .... 33,023 to 33,025
Candies, M. S. Cutting 33,031
Canned and preserved goods and food condiments, certain, Erie Preserving Company 33,036
Carpet sweepers, Grand Rapids School Furniture Company 33,055
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Cotton fabrics, Bernheimer & Walter 33,022
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Flour, meal, and peanuts, W. A. Whitehead & Son 33,043
Flour, self raising, Sleepy Eye Milling Company .. 33,039
Flour, wheat, Donmeyer, Gardner & Company, 33,040, 33,041
Flour, wheat, J. G. White & Company 33,042
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Pen, steel, Ormiston & Glass 33,014
Perfumes, toilet waters, and colognes, Ladd & Coffin 33,027
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Photographic developers, J. Hauff & Company, Gesellschaft mit Beschrankter Haftung, 33,016, 33,017
Plasters for corns and bunions, Probus Remedy Company 33,049
Salves and ointments, H. R. Gault 33,048
Sensitizing material, Haller-Kemper Company 33,018
Sheet metal and articles manufactured therefrom, nickelized, American Nickeloid Company 33,052
Shoes, ladies', Krippendorf-Dittmann Company .. 33,019
Soup stocks and flour made from cooked grain or seeds, McMorran & Company 33,035
Sulphur for use in baths, preparations for production of mascent, Ballard & Herman 33,050
Tea, coffee, and cocoa, Peek, Frean & Company .. 33,032
Tea, herb, I. Caldwell 33,045
Toilet preparations, certain named, Ladd & Coffin 33,028
Twine, Portland Cordage Company 33,021
Umbrella handles, composition for, United States Chemico-Wood Company 33,030
Washing fluid, H. Blum 33,029

LABELS.

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"Aunt Edith's Liniment," for a liniment, E. A. Davis 6,959
"Benedict," for cigars, cheroots, and cigarettes, L. A. Schaeffer & Company 6,948
"Burnham's Cream Custard," for a food preparation, E. S. Burnham Company 6,950
"Dr. Bailey's Catarrh Cure," for a catarrh cure, Bailey Remedy Company 6,954
"Dr. Bean's Guaranteed Toothache Cure," for a medical compound, W. G. Bean & Company 6,956
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"Faceline," for a face cream, W. H. Lotz 6,947
"Gobel's Rose Bud Gum," for chewing gum, W. H. Gobel 6,949
"Khasan's & Rosenweig's Emulsio Hypophosphatis Creosoti Comp." for a medical compound, Khasan & Rosenweig 6,958
"L. A. W. Headache Cure," for a medicine, H. H. Bulger 6,955
"Sure Death," for insect paste, C. V. Eckert 6,960
"Tiger Brand," for Portland cement, Castalia Portland Cement Company 6,953
"Urban and Suburban Mixed Paint," for mixed paint, Cawley, Clark & Company 6,951

PRINTS.

"Eddy Valves," for valves, Mohawk & Hudson Manufacturing Company 144
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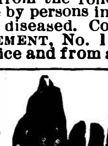

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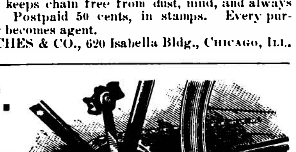

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